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CIVIL ENGINEERING.

Twenty-first Annual Report of the President and Directors to the Stockholders of the Baltimore and Ohio Railroad Company.

At a meeting of the stockholders, held pursuant to the charter, on the second Monday of October, 1847, in the city of Baltimore, the President and Directors of the Baltimore and Ohio Railroad Company submitted the following report and statement of the affairs of the Company:—

FIRST.—*Of the Main Stem.*

The statement A shows the state of the Company's affairs on the 30th ult., and the revenue and expenses of the *main stem* for the year ending on the same day are shown by the statement B.

These statements exhibit a considerable increase both in the trade and travel; and it will appear, from an examination of the various items of which they are composed, and from the elaborate report of the chief engineer, acting as general superintendent, hereto appended, that in proportion to the amount of business, there has been a very favorable diminution in the cost of transportation and expense of working. The general economy in the management of the road, either in regard to its particular condition, or as compared with other roads in the United States, or elsewhere, though more favorably situ-

ated, is also worthy a particular notice, and ought not to escape the attention of the stockholders.

The gross receipts from the business of the *main stem*, independent of its connexion with the Washington road, amount to the sum of $1,101,936·58, and the expenses of working and management, of all kinds, to the sum of $590,828·98, little more than 50 per cent. of the gross receipts, and leaving a balance of net earnings, over all expenses of working, of $511,107·60, being more than seven and one quarter per cent. upon the capital. Without reference to the detailed statements and observations in the report of the chief engineer, and to the subsequent remarks in this report, or to the working of other similar roads, this result would establish the general economy in the administration of this work, and show that the cost and expenses of transportation bear a reasonable and economical proportion to the entire receipts from the trade and travel. If, therefore, there were no other objects to which the Board were under an obligation to apply the above stated net receipts, the dividend for the present year, under the present system of management, might not have been less than seven per cent., and the necessity of applying them to other objects, however it might be regretted, has been altogether unavoidable.

The stockholders were informed in the last annual report, that engagements made prior to the month of September, 1846, for reconstruction of thirty miles of the old track. for new locomotive engines, for new burthen cars, and for improvements at the several depots, stated in that report at $325,000, would be chargeable upon the receipts of the year just closed; and that by the interest upon the bonds then authorized to be issued, and the instalment payable during the year to Messrs. Baring, Brothers & Co., the amount so chargeable would be swelled to an aggregate of not less than $418,000.

It is now to be observed that the payments during the year on account of all the foregoing items, have actually amounted to the sum of $403,662·63, and that from the receipts of the year there has also been paid, on account of surveys west of Harper's Ferry, for interest on temporary loans, rendered necessary to meet the engagements of the previous year in anticipation of the accruing revenue, and for additional burthen cars, indispensable to comply with the more pressing demands of the increasing trade, the further sum of $37,534·10.

Of the net earnings, as shown above, not expended on account of capital, and which it is in the power of the Board to replace by the sale of their six per cent. bonds, the Board have declared a dividend of three dollars upon each share, and applied the further sum of $20,000 to the sinking fund—provided, as stated in former reports, for the reimbursement of the loan of $1,000,000 on account of the Washington road, leaving a surplus to be reimbursed from the cost of reconstruction by the sale of bonds, of $23,916·50.

It ought also to be observed that while, from the causes already explained, the dividend to the city and individual stockholders does not exceed three dollars per share. the State of Maryland has derived much greater advantages from her connexion with this enterprise. The subscription of $3,000,000 made by the State, in 1836, with the

distinct understanding that both the city and State should at the time contribute an equal sum, was paid in five per cent. sterling bonds; and that, although the subscription by the city has been fully realized and applied to the construction of the road to Cumberland, yet, that in consequence of the depreciated credit of the State, the sterling bonds received from the Treasurer have remained for the most part unavailable. Of the entire sum of the $3,000,000, an amount not exceeding 5000 pounds sterling has been disposed of, and while the Company has continued regularly to pay the interest upon that amount to the bondholder, the State, during the whole period, has annually received larger sums from the Company than any other stockholder.

During the past year, including the bonus, the State has received from the earnings of the Washington road, an amount equal to ten per cent. upon her subscription to that road—and with the dividend from the earnings of the main stem, has actually received a sum equal to seven per cent. upon her investment in both roads.

Of the revenue heretofore applied to reconstruction, the Board have replaced, during the year, the sum of $49,105·12 by the sale of their six per cent. bonds, at prices averaging about their par value: and it may be added, that, by the consent of the city authorities to receive the present dividend, payable to the city in the same securities, the Board will be enabled to make a further sale of the same description of bonds to the amount of $105,000, at their par value.

It is proper also to state, that during the past year the Board have entered into contracts, within the estimates of the engineer, for the further reconstruction of 31 miles of the old track, payable partly in the Company's notes at long credits, and partly in the six per cent. bonds alluded to in the last annual report, at par; and that they have also entered into contracts in the further amount of $152,872, being about $46,000 less than the cost estimated by the chief engineer, for indispensable alterations in certain parts of the old track, payable altogether in similar six per cent. bonds of the Company at their par value. For so much of the foregoing engagements as are payable in the notes of the Company, the Board must look to the sale of their six per cent. bonds, or to loans in another form; and, until one of these can be effected upon favorable terms, the current receipts must be used. The effect, therefore, upon the dividend of the current year must depend upon the success of one of the first resources.

A proper regard to the increasing trade and travel upon the road, and to its economical working, and, what is of even greater importance, to the safety of the public, would not permit a thorough reconstruction of the old and imperfect track to be longer delayed. By some, or all of the resources at the command of the Board, these objects must be accomplished with the utmost possible despatch; and the duty of the Board will only be discharged by accomplishing them according to their best judgment, with all the means at their command, and in a manner the least onerous to the stockholders.

Up to this time, it is not doubted, that an impartial examination of the subject will satisfy the stockholders, that in the discharge of the

arduous and multifarious duties devolved upon the Directors, the Board have practised a due economy and carefully guarded the interests entrusted to them.

The exhibition they are now enabled to make of a net earning of more than seven and one quarter per cent. upon the capital, over and above all the current expenses of working and management, including extraordinary repairs of the road way, bridges, and machinery of all kinds, is not only a conclusive evidence of the economy with which their duty has been performed, but ought to afford substantial evidence of the future profits of the work, and of the stability of the Company's credit. This part of the subject, however, cannot be properly understood or appreciated, nor will the stockholders be able to do justice to the present condition or future prospects of their own enterprise, nor properly sustain its credit, without bearing in mind that their work is, and for some time must remain, in an unfinished state—unfinished, not so much in regard to the termination to which it is designed ultimately to extend it, but, what is equally important, and to this occasion more pertinent, unfinished in regard to its capacity and power of operation throughout the present line. It would be a grave error, leading to serious and perpetual misapprehension, to conclude that a railroad, actually constructed between two given termini, was thereby finished and requiring no farther expenditure from the application of its resources to the purposes of capital. A railroad can be said, in no sense, to be finished until it is not only constructed and open for trade between two given points—the road must be considered as unfinished until it can be supplied with all the power and machinery of every description necessary to accommodate the public, and effectively and economically to conduct its daily operations. In all railroad companies in all countries, this obvious view of the subject is universally conceded and acted upon, and everywhere the cost of a road, and of all other objects comprehending its capital, is understood to include, not only the actual construction of the road way, but the supply of all the stations, depot buildings, engines, cars, and machinery of all kinds necessary to its effective operation. Until, therefore, a railroad is not only actually constructed, but provided with all that is necessary for its effective working, it must remain unfinished; and, while it is the duty of the company to proceed to finish the work in their charge with all proper energy, the only means by which it can attain that object, is an increase of its capital by new subscriptions, or by some form of loan, for the reimbursement of which, both principal and interest, the annual receipts are the only resource. The stockholders will scarcely need to be informed, that not only the present road from Baltimore to Harper's Ferry, in consequence of the radical imperfection and defectiveness of the original construction, is yet unfinished, requiring a large annual expenditure to complete it; but that in regard to the necessary stations, depot buildings, and cars, and machinery of every description, the whole work is yet unfinished, and on this account annually absorbing a considerable portion of the receipts to supply the defects. It must, then, be apparent that any unfavorable disproportion between the rate of the dividends and the

amount of the net earnings, can in no degree be attributable to improper expenditure in the working, but arises wholly from an unavoidable necessity of applying so large a proportion of the receipts to put the road in a finished state, to adapt it to the just demands of the trade, and to render it ultimately profitable to the stockholders. It is seen that during the past year, under the present economy, if the defectiveness of the road and inadequacy of the machinery had not required such a heavy expenditure, the net earnings of the year would have justified a dividend to the stockholders of seven and a quarter per cent.; and yet, that in consequence of the necessity of such an expenditure, the Board have been compelled to confine the dividend to three per cent., and temporarily to apply at least four per cent. of the net earnings towards completing the work.

It may not be out of place, in this connexion, and for better illustration of this part of the subject, to state, that from the opening of the road to the year 1837, inclusive, (a period of eight years.) the gross receipts amounted to $1,439,151, the *expenses* to $1,038,818, the dividends to $144,138, and the expenditure, on account of capital only, to $247,195. From the close of the year 1837 to the end of 1847, the gross receipts have been $5,979,097, the expenses $3,332,783, the dividends, $735,000, and the expenditure on account of capital $1,911,314. So that, from the opening of the road to the present time, the stockholders have received of its earnings $879,138, and the expenditure for general objects of capital has been $2,158,509. The ratio of expenses to receipts prior to 1837 was $72\frac{7}{10}$ per cent., and from 1837 to 1847, the ratio has been $55\frac{7}{10}$, while the excess of current receipts over current expenditure, prior to 1837, was $391,333, and subsequent to 1837 it has been $2,158,509.

In yielding to the necessity which has thus been explained, the Board have only followed the example of all others engaged in the management of similar works, practising, as they believe, not less economy than any other administration of railways that they might be required to imitate; and while it may be expected of the public at large to be satisfied with so liberal a provision for the accommodation of the business, the stockholders, in view of the ultimate benefits to flow from it, will, it may be hoped, be content with a policy dictated no less by the necessity of the case, than their own duty and true interest.

The result of this policy, and the economy with which it has been carried out, as well as the beneficial effects upon the interest of the stockholders, may be seen in the progressive improvements in their own enterprise, and in its present condition and future advantages.

The influence of the administration of the present Board cannot be traced to an earlier period than the middle or close of the year 1837. In that year, the length of the road being 82 miles, only 157,102 passengers, and 66,703 tons were carried in the cars, and the machinery imperfectly adapted to that amount of business: in the present year, upon a road of 178 miles, there have been transported 288,674 passengers, and 263,334 tons; and, unless from sudden accumulation at unexpected and temporary periods, there has been no deficiency of

power or means. Anterior to the year 1837, and up to the year 1835, there had been only five small dividends, varying from 37½ cents to $1·12½ per share, and from 1835 to 1840, no dividend had been declared.

In 1837, the outstanding current obligations of the Company were not less than $130,000, and the aggregate expenses of working the road only, was at least ninety-five cents in the dollar! As might have been expected from this result, the power and machinery of the Company were inadequate even to the inconsiderable business of that period; and only seven hundred and fifty thousand dollars of the original subscription remained unpaid, which, in a few years only, must have been needed for the payment of debts, and for the augmentation of machinery, leaving other objects of expense swelling beyond any resources at the command of the Company. How long, under a continuance of such causes, the road could have been kept in operation, it would now be needless to conjecture. At the end of the year 1840, a period of two years, the remaining capital had been called in, punctually paid, and applied to the reduction of the inclined planes at Parr's ridge, to the removal of other sources of perpetual and wasting expense, and to the augmentation of machinery of all kinds. During the same time, an improved system of repairs of roadway and machinery was adopted—the outstanding obligations of the Company were fully discharged, and a dividend of $2 per share was paid to the stockholders out of the net earnings. During those two years, the construction of the road west of Harper's Ferry was commenced, under circumstances in many respects unpropitious, and as early as the month of November, 1842, from the proceeds of the city subscription of $3,000,000, and the application of a considerable portion of the annual receipts, was completed as far as Cumberland, a distance of 96 miles, at a cost not less than $3,623,606·28.

During the period subsequent to 1840, a dividend to the stockholders was intermitted for a single year only, the earnings of the year 1842 having been applied to the extension of the road from Harper's Ferry to Cumberland. In 1841 and 1843, the dividend was $2 per share; in 1844, $2·50 per share; and in 1845 and 1846, $3 per share.

The comparative progressive improvement in other respects, during the same period, subsequent to 1837, is not less striking. In that year, the Company owned only fourteen locomotive engines, and these of the fourth, or smallest class, of which some were actually unfit for use, and the whole, more or less, in an imperfect condition. From that time to the present, the motive power of the Company has been increased, by purchase or otherwise, of thirteen of the largest class, two of the second, twelve of the third, and eleven of the fourth class, in all thirty-eight, and in actual capacity equal to seventy-two of the class of those employed in 1837. The augmentation and improvement in the number and condition of the cars and other machinery may be taken to be in the same proportion.

In 1837, the cost of repairs of road and bridges, the latter being comparatively few in number, was not less than at the rate of $1203 per mile of road, and at the end of 1846, before the occurrence of the

adventitious and temporary causes adverted to and explained in the report of the chief engineer hereto appended, notwithstanding an increase of nearly three-fold in the business of the road, and a considerable addition to the number of timber bridges, the cost of similar repairs did not exceed $918 per mile of road, being about twenty-five per cent. less than at the former period. The cost of repairs of machinery, engines, and cars, in 1837, was at the rate of $29\frac{3}{10}$ cents per mile run by the locomotives with trains, and in 1846, the cost did not exceed $16\frac{1}{10}$ per mile run; being little more than one-half of the former cost, although the trains hauled in the last year were, in all instances, considerably larger. In 1837, the aggregate expenses of working the road, exclusive of the expense of horse power in the streets of Baltimore, and over the old inclined planes at Parr's ridge, was at the rate of not less than 173 cents per mile run by the locomotives; and in 1846, the same expenses did not exceed the rate of $59\frac{8}{10}$ per mile—nearly two-thirds less than in the former period.

It has been already stated, that the proportion of the expenses of working the road to the gross receipts in 1837, was as much as 95 per cent; and it may now be added, that in 1846, the same expenses did not exceed 52 per cent. of the gross receipts. It must be observed, moreover, that this great reduction has been effected under the influence of a vastly augmented trade, of a continued dilapidation of the old and imperfect track, of a considerable multiplication of timber bridges, and of a reduction in the charges for transportation of more than 35 per cent. below the rates in 1837.

Excepting in Great Britain, where the rates of charges are high, and the wages of labor low, and where the receipts from passengers, always the chief source of profit upon railways, are much greater in proportion to those from burthen transportation, the expenses of working railways rarely, if ever, fall short of 50 per cent. of the gross receipts, and in most parts of the continent of Europe, and elsewhere, they more frequently exceed that ratio. It is to be observed, moreover, that this proportion is seldom or never maintained, except in the instances of new and well constructed railways with the most improved rail and form of structure, and with the aid of other advantages indispensable to the cheap management of such works, and where the receipts from profitable passenger traffic considerably exceed those from the transportation of burthen. Independently of the railways in England, the ratio of expenses to the gross receipts, and the economy in the working of the Baltimore and Ohio railroad, will be found to compare most advantageously with all the European works, the former being less and the working cheaper than upon the European works.

The roads in New England possess most of the advantages of newness and strength of construction, of liberal charges and large trade, and from the density of a general and manufacturing population, derive larger receipts from passenger traffic than from tonnage; and are also universally conceded to be conducted with commendable regularity and economy. They possess besides many material advantages peculiar to that part of the Union, which would enable them to attain

a superiority over even the skill and economy of European works, which it would be difficult successfully to imitate.

With all these advantages, an investigation into the comparative cost and expenses of working the Baltimore and Ohio railroad, and of the principal New England roads, according to information derived from authentic sources, would still further illustrate the economy with which the operations of this road have been conducted.

The average cost per mile of twelve of the principal railroads of New England, including their necessary equipment, may be stated at $46,000, and that of the Baltimore and Ohio railroad, including the thirty miles reconstructed during the past and preceding years, may be taken to be about the same. If the cost of reconstructing the remaining portion of the old track, and of the alterations now in progress, be added, the average cost of the road would be more than $50,000 per mile. The average of all the expenses upon eleven of the principal New England roads per mile run by the locomotives with trains, during the year 1846, was not less than $78\frac{1}{10}$ cents; and that upon the Baltimore and Ohio railroad, during the same period, exclusive of the cost of horse power in the streets of the city, was, as before stated, not more than $59\frac{8}{10}$ cents; showing a difference of nearly twenty-five cents in favor of this road.

The average of the proportion of expenses to the gross receipts upon the eleven New England roads, during the year 1846, was a fraction over fifty per cent., and that of the Baltimore and Ohio railroad, during the same period, may be stated at not more than fifty-two per cent. If, in regard to this part of the comparison, the superior construction and comparative newness of the New England roads, their exemption from the employment of horse power in cities, and the greater amount of passenger traffic in proportion to that of burthen, be taken into consideration, (that on the Baltimore and Ohio railroad being $654,916·14 from tonnage, and only $447,020·14 from passengers,) the cheapness of working this road would be apparent. Of all these facts and grounds of comparison, therefore, it may be safely predicated, that, as soon as the old track of the Baltimore and Ohio railroad shall be thoroughly reconstructed, and, by an adequate provision of motive power and other machinery, and of depot buildings, necessary for its general purposes, the entire road shall be placed in a finished state, the general expenses will not exceed the best economy upon any other work.

Notwithstanding, however, the confidence of the Board in the results already adverted to, and in the general system of management gradually adopted subsequent to the year 1837, they have not been insensible to the necessity of adapting it, from time to time, more perfectly to an extended road, to a rapidly increasing trade, and to the great augmentation of power and machinery demanded by the increasing business. The accumulated business, in the year 1846, and the near approach of the periodical renewal of the timber of the road over its entire line, presented an appropriate occasion to revise the general system of management, and in the month of November last, the President suggested a scheme of a modified system, and invited

the attention of the Board to the necessity of a particular examination into the present organization of the Company, and to the introduction of some reforms which he thought might be advantageously made. He also asked the appointment of a committee by whom he might be assisted in the investigation, and in maturing the reforms that might be deemed expedient. The principal objects to be attained, by the proposed modifications, consisted in confining the general supervision and superintendence of all the departments nearer to their duties, and, by a judicious subdivision of labor, to insure a proper adaptation and daily application of the supervisory power to the objects under its immediate charge; in the multiplication of checks, and to effecting a strict responsibility in the collection and disbursement of money; in confining the Company's mechanical operations in their shops to the purposes of repairs, rather than of construction; in promoting the economical purchase and application of materials and other articles needed in every class of the service; and in effecting a strict and more perfect responsibility in the accounting department generally.

After diligent investigation, with the aid of the experience of other roads in New England, and elsewhere, the committee proposed to attain the foregoing objects by confiding the departments of transportation, of the construction and repairs of the road, and of the repairs of machinery, to a separate superintendence; each being subject to the immediate supervision of a professional engineer, under the direction of the President.

They subjected all these officers, and all other principal agents, to an annual appointment, and required satisfactory security for the faithful performance of his duties from each. They also adopted measures for the purpose of confining the receipt of money to as few agents as possible, and for insuring the prompt payment from all of monies received by them; and they prescribed a new and securely guarded system of tickets, recommended by the best experience in other companies; and imposed further checks upon conductors, and other agents, which were thought would prove effective in enforcing a rigid accountability from all. They revised and remodeled the system of accounts, and, by bringing them into the Company's office, effected a daily accountability and settlement of the account of each of the agents by the Treasurer and Secretary, under the immediate supervision of the President.

It is not proposed in this place, to do more than indicate the general features of the modified system now adverted to. It was adopted by the Board as proposed by the committee, and, as far as can be inferred from its operation, it is believed that, with such improvements as practical experience may suggest, it will fully realize the advantages expected from it, and effect all the security of which the case is susceptible. It may be further observed that, although in the execution of the system, the duties of some of the old agents were materially changed, and in some instances the employment of new ones was required, yet it has been so arranged, as that by reducing the salary of those whose duties had been lessened, the aggregate expense of the whole is less than was paid under the system it superseded. The re-

port of the chief engineer, acting at present as general superintendent, hereto appended, will not only disclose the present working of the system, so far as tested by practical experience, but also contains, in addition, a general professional exposition, by that officer, of the state of the road and machinery, and of the working and operation during the year; and, by its statements on these points, will dispense with further observations in this report upon the same topics.

SECOND.—*Of the Washington Road.*

The affairs of the Washington road are shown by the statements D and E.

It will appear from these statements that there has been a falling off in the receipts from this road, and that the diminution has been in the passenger traffic. During the past year the number of passengers has been five thousand four hundred and three less than in the year 1846, and the amount of revenue received from this source has been eleven thousand eight hundred and nineteen dollars less than in the preceding year. It may also be stated, that during the past year there was an increase in tonnage transportation of 3,109 tons, and of $2,198·87 in the revenue from that source over the year 1846. It may be inferred, therefore, that the experiment of a reduced charge, authorized by the Board in the years 1845–46, has not realized the expectations by which it was recommended; and the conclusion would seem to be warranted, that the lowest charges do not uniformly increase the amount of travel. It will, therefore, become the duty of the Board to reconsider the subject with the benefit of the experience they have already had, and to make such addition to the present charges as a full investigation may be found to authorize. The net profits from the Washington road, for the last six months, including the surplus of $6,724·19 remaining after the dividend in April last, amount to the sum of $48,131·66, of which the Board have declared a further dividend for the last six months of $2·50 upon each share of stock, leaving a surplus of $6,881·66, to be carried to the account of the current year.

THIRD.—*Of the further prosecution of the Road to the Ohio River.*

Under this head the Board are gratified to be enabled to congratulate the stockholders, that by their action on a recent occasion one of the obstacles that has hitherto retarded the extension of the road to its ultimate destination, has been removed.

By an act of the Legislature of the state of Virginia, passed at the last session, the grant of the right of way through that state has been renewed for a period of twelve years, upon condition that the road shall be extended to the city of Wheeling without touching the Ohio river at a point lower down than the mouth of *Fish* creek; and according to the agreement with that city, the option of extending the road by the latter point is absolute.

The Board is not aware that until very recently any diversity of opinion existed with the public authorities, or in the community at

large, of the expediency of extending their road to a southern point on the Ohio, from which they could, with the least competition, command the trade and travel passing up the river, and most certainly form connexions with the improvements of Ohio, upon both the central and southern lines, on which they have been projected in that state. And the Board do not doubt that it is the clear, unquestionable policy and duty of the stockholders, of the state, and especially of this city, by the extension of their road to a southern point on the river, to attract the western improvements from any other point to which they might possibly be diverted, and at which they would be brought within the attraction of the rival cities north of Baltimore. A connexion with the western roads in the state of Ohio, upon either the central or southern line, in that state, would be indispensable to the success of this enterprise, and its ultimate object could be most effectually obtained by extending it so as to connect with both, and without the risk of competition with the northern rivals. In the earlier history of the company, greater reliance than at present was placed upon the river trade and travel, and the city of *Wheeling* was considered by the projectors of the road as not only commanding these, but at the same time insuring a connexion with the railroads on the central line of the Ohio improvements. In all the applications of the company for the right of way through the state of Virginia since the year 1842, however, the company have asked for the option of extending their road to any point on the Ohio within that state they might select above the mouth of the Little Kanawha, intending, undoubtedly, to terminate it at some point within that range of choice. Within those limits the selection must have been, and was expected to be regulated so as to insure a connexion with the Ohio improvements, both on the central and southern lines; and it would have been necessary to avoid a terminus so far south as might force the improvements on the *central* line to a more northern point on the river, beyond the reach of this road. It had been, until recently, supposed that the mouth of *Fishing* creek, twelve miles below *Fish* creek, presented the best medium point for both purposes; and the impression generally prevailed, that while the improvements on the southern line in Ohio could certainly connect more advantageously at *Fishing* creek, those on the central line could also be more easily formed at that point than at Wheeling. From subsequent information, however, it would appear that the *central* improvements in Ohio may connect with this road on the river as advantageously at *Wheeling* as at *Fishing* creek; while it is certain that the improvements projected on the southern line might form a connexion at *Fish* creek, without increasing their length, or the distance between Cincinnati and Baltimore more than twelve miles.

The distance from Cincinnati to Baltimore on the southern line through Ohio, by the mouth of *Fishing* creek, may be stated at 600 miles, and to New York 800 miles; and to Baltimore, by the way of *Fish* creek, 617 miles, and to New York, by the same point, 817 miles. While, therefore, from Cincinnati to New York, by the way of Fishing creek, the distance would be 109 miles less through Balti-

more than by the northern route projected to New York, the distance to New York by way of Fish creek would be still 92 miles nearer through Baltimore than by the northern route.

In this view of the subject, and deeming it inexpedient to hazard the extension of their work upon the future legislation of Virginia, the Board thought the prosecution of the road to Wheeling by the mouth of Fish creek would insure, effectually, a connexion with the Ohio works, on both the lines projected in that state, and still enable them to maintain a successful competition with New York.

They do not consider that the projectors of either of the lines in the state of Ohio should attempt or expect to exclude the other from a connexion with this enterprise at a point most acceptable to it; and in the arrangement this company have made with the city of Wheeling, and by accepting the Virginia law subject to its provisions, it must be conceded that the Board and the stockholders have made a better compromise and accomplished more for those interested in the *Southern* line of improvement, than the same parties have been able to effect in any other way. It is to be observed, moreover, that the cost of the work to the Ohio, by *Fish* creek will not be greater than to *Fishing* creek; and that, with the aid of the subscription of half a million of dollars and the gratuitous grant of a depot and right of way to be contributed by Wheeling, the company will not have less ability to execute their engagement with the authorities of that city than if they had succeeded in their object of terminating the road at *Fishing* creek.

It may be assumed, therefore, that in accepting the Virginia law, and confirming the agreement with the city of Wheeling, the stockholders have not only consulted the interests of the several companies engaged in making the improvements on the southern and central lines of Ohio, and insured the connexion of both with their road; but have acquired the right of reaching the Ohio at the point originally contemplated by the state and the city, with the additional and important privilege of extending it twenty-eight miles lower down the river than they originally desired to do or could have done at any time since the spring of 1838. They may thus be enabled to accomplish their original object without the necessity of constructing a rival branch to their main stem, thereby attracting the travel and trade to a rival city; while, by encouraging a connexion of their road with the improvements on the southern line in Ohio, they offer new inducements to the works on the central line to form a similar connexion, in preference to longer and more expensive lines to any Northern point.

Looking to these objects it will now be in the power of the company, by a vigorous and energetic prosecution of their road, in conformity with the law and the agreement with the city of Wheeling, speedily to realize all that ever has been hoped from the enterprise.

It is not to be concealed, however, that for the accomplishment of this object, the united and cordial co-operation of those interested in the prosperity of the company and this city, will be needed; and the Board will not doubt that it will be effectively afforded. For twenty

years the stockholders, under the auspices of the state and the city, have been exerting all the means at their command to extend the *Main Stem* of the road to a point on the Ohio not further north than *Wheeling*, and in 1835, the state and the city proposed a liberal amount of aid to effect that object. The universal depression in the public credit which soon followed these efforts, and the expiration of the time limited in the acts of Virginia and Pennsylvania, temporarily defeated the purpose. For the last ten years no exertion has been spared to obtain a renewal of the right of the way, within the limits of the original Virginia grant. These exertions have finally resulted in a choice of routes less restricted than that accepted in 1838,—and not only in confirming the terminus deliberately and definitively adopted in that year, but in enlarging the route, so as to embrace a more southern point, accessible to connexions which might not have been commanded from *Wheeling*. For the accomplishment of this enlarged and more comprehensive object, there will be less distance, and fewer difficulties to overcome, and a less amount of capital to be employed than would have been necessary, if the work had been extended under the laws in force from 1838 to 1843; and it is not to be presumed that having succeeded to an extent so much beyond their early hopes and expectations, any of those who have heretofore deemed the completion of the enterprise so essential to the prosperity of Baltimore, will abate any of their zeal and energy. The Board would have greatly mistaken the objects and purport of the trust confided to them, if, succeeding in their efforts, after so much toil and so many discouragements, they were not cordially supported in the prosecution of their work; and the stockholders, if they neglected or failed in the necessary energy to use the opportunity they have deliberately sanctioned, would, in all reasonable probability, forever prevent the extension of the road to any point west of Cumberland. There is no occasion, and the Board have no disposition, to arraign opinions which, amid the uncertainty and discouragement of obtaining the right of a terminus at a southern point, may have grown up in any quarter, favorable to a different and more northern line. So far as such opinions may have sincerely desired an early prosecution of the road to the western waters, and, from an apprehension that, either from the want of authority or of adequate means, the best would not be accessible to the company, advocated the adoption of an inferior line, rather than not go forward, they may be entitled to respect.

Opinions of this description, however, have no longer any reasonable pretext for their maintenance, more especially if an unreasonable persistence in them would most probably entail upon the community even greater mischief than they professed to avert. It is impossible that the subject could have been more thoroughly investigated, or more maturely considered by all that could be expected to take an interest in it. In the various and elaborate discussions to which, through a period of ten years, it has given rise in the legislature of a sister state, and in the mass of facts and information developed in the course of an intelligent and free examination of its merits in this community, every thing that could assist the mind in forming a sound

conclusion, has been elicited. The Board are not at liberty to suppose that those who have been called to pronounce their final judgment upon a subject of so much importance, and so deeply involving public and general interests, could be guided by any other considerations than those identified with the successful prosecution of their enterprize, and with the trade and commercial prosperity of this city; and to say that those by whom the ultimate decision was made, thoroughly knew and comprehended the advantages on one side and the hazards upon the other, and perhaps more than any others would seriously suffer from a mistaken course, would only be to say what would be felt and acknowledged by all.

The present enterprise in charge of the stockholders may emphatically be said to be essentially a work upon which the prosperity of Baltimore is dependent. It has already absorbed three millions of capital of individuals interested in the prosperity of the city, and three and a half millions of that of the corporate authorities, to be justified only by such an extension of the road as would increase the trade and augment the value of every species of property; and it must not be overlooked that, of the assessment, in any form whatever, that may be necessary to refund to the state the annual interest upon her loan to the company, a full moiety, at least, must be borne by the authorities and people of Baltimore. In such a case, therefore, whatever diversity of opinion might at any time have prevailed in quarters and upon grounds already alluded to, it would be only reasonable and just towards all the great interests involved, after a final decision of the subject by so large a majority, that all interests would unite in rendering the decision effectual.

It is a great misfortune that ten years have already been spent in seeking the right to extend the road to the Ohio; but if, after obtaining it, upon terms satisfactory to a large proportion of those principally and substantially interested, ten years more are to be wasted in controversies respecting a route, or in excited struggles to reverse the decision already made, it would not only add to the misfortune of the past,—it would be in every view of the subject fatal. In the present condition and progress of improvements in other states, a stationary policy upon the part of this community could not be otherwise than fatal to their prosperity. If they do not now make an effort to extend their great work to the Ohio, other states will soon complete their exertions to attract the trade and travel of the West into other channels, and to cities of greater capital and other advantages, from which we will not be likely at any future day to divert them. That all the advantages, and any amount of trade that could ever have been anticipated from the extension of the road to the Ohio, may be commanded, and at no greater cost, by the route, and at the point selected by the stockholders, has not been, and cannot be denied; and if any attempt to embarrass that selection, by active opposition or a withdrawal of support, by ultimate defeat, or unreasonable delay, can end in any thing short of a total destruction of all the great objects of the enterprise, the Board have not been able to conjecture it. For an object of such magnitude, therefore, appealing to so many in-

terests, promising so many advantages, which, in fact, is so necessary to the commercial prosperity of Baltimore, and to the development of such an important region of the state that could not be developed by any other line of road, the Board must continue to rely upon the cordial co-operation of all those interests which it has been their constant aim to promote.

Thoroughly impressed with a sense of their own duty in this posture of their affairs, the Board are prepared to exert their utmost resources and energies to press forward their work in good faith, in conformity with the authority now conferred upon them, and pursuant to the arrangement with the city of Wheeling. Their last duty, and the first measure devolved upon them, will be by minute instrumental surveys to discover and adopt the cheapest and best line, and to obtain the right of way, and establish the location preparatory to the requisite contracts. Several parties of engineers are now in the field, and it is hoped that the surveys, on the preferred route through this state, to the Virginia line, may be completed during the present year. It would undoubtedly be the duty, and is the wish of the Board to extend the road from the city of Cumberland to Wheeling in part through this state, rather than confine it, as they may do, entirely to the state of Virginia. It has already been hinted that the extension of the road upon the line through Maryland would immediately develope the coal and iron deposits near the Potomac, and the important agricultural resources of the Glades, which would be wholly neglected by a line through Virginia, or even through another part of this state in pursuit of a more northern terminus. On this ground as well as to accelerate the completion of the surveys and the progress of the work, the route through Maryland ought to be preferred. If, however, from any sufficient cause whatever, the Board should be called to leave the state of Maryland, and confine their route to the state of Virginia, their operations would only be retarded. In any event they will indulge the hope of being able to complete the surveys and final arrangements for the right of way, so as to locate the line from Cumberland to Wheeling and place it under contract in the course of the next season.

It will be the duty of the Board to employ the interval in devising the means, and effecting their financial arrangements to prosecute the work with the least possible delay; and although they deem it premature at this time, and in this place, to advert in detail to the various sources and modes of arrangement from which they expect to obtain the means of prosecuting and finishing the road, they have reason to hope that the measures they have in contemplation for those objects will not be unsuccessful. They indulge only a reasonable confidence, moreover, in believing that they will have at their command available and important resources which may be obtained for the prosecution of the road authorized by the Virginia law, and the arrangement with Wheeling, that could not, by possibility, be commanded in aid of a road to a more northern point on the Ohio; and they cherish the hope that the temptation they will be enabled to offer to capital, and the just appeal they may make to all the great in-

terests involved in the accomplishment of the work, will not be made in vain.

In conclusion, the Board can only promise the faithful and energetic performance of so much of the duty appertaining to the prosecution of the work as is devolved upon them. If, after this, the enterprise be destined to failure, the Board, at least, will stand acquitted.

In connexion with this subject, and in further explanation of the recent law of Virginia and the agreement with the city of Wheeling, as well as for the purpose of bringing together the present state of the company's affairs, and the general grounds upon which the stockholders may be supposed to have made their recent decision, the Board have deemed it expedient to append to this report, the report and documents accompanying it, of the committee by whom the arrangement with the city of Wheeling was concluded.

By order of the Board,

LOUIS McLANE, *President.*

October 1st, 1847.

(A)

DR. *The Baltimore and Ohio Railroad Company.* CR.

Stock in the Washington Branch Road,	$1,032,600·00	Loan at six per cent.,	$1,000,000·00
Cost of road to Harper's Ferry, including real estate and depots, locomotives, passenger and burden cars, &c., &c.,	4,000,000·00	Loan No. 2, at six per cent.,	145,681·53
		Bonds issued indemnified from State and city taxes,	49,105·12
		Stock,	7,000,000·00
Cost of road west of Harper's Ferry,	3,623,606·28	State of Maryland five per cent Sterling bonds,	3,200,000·00
Reconstruction of the road east of Harper's Ferry,	441,991·29	Baring, Bros. & Co., London, for balance now due,	53,708·95
Sterling bonds in the hands of Messrs. Baring, Brothers & Co., of London,	3,181,005·11	Bills payable, for amount of promissory notes out,	109,213·05
		Forfeited stock, for balance of that account,	183·45
Stock in the Pittsburg and Connellsville Railroad Company,	1,750·00	Revenue, for balance to the credit of that account, $1,716,450·53	
Sinking fund, for the redemption of the million loan,	76,000·00	Less expenses, repairs and interest, including the sum of $248,250 23, expended for locomotives, burden cars, improvements at depots, and various purposes on account of construction, 839,079·21	
Invalid fund, for amount due by that account,	196·28		
Maryland and New York Iron and Coal Co., due by them,	13,627·69		
Cash in the hands of officers,	8,970·87		
Cash on hand,	*55,515·90		877,371·32
	$12,435,263·42		$12,435,263·42

J. I. ATKINSON, *Treasurer.*

Office of the Baltimore and Ohio Railroad Company, Oct. 1st, 1847.

* To the sum is to be added a dividend of 2½ per cent. from the Washington road, $25,815, and $12,869 51 of debts to be collected, which will make the actual cash balance the sum of $94,200·41.

(B)

Statement of the Revenue and Expenses of the Baltimore and Ohio Railroad Company, on account of the Main Stem of the road, for the year ending the 30th of September, 1847.

The amount received for transportation of Passengers, Mails, and Merchandize, for the year ending the 30th of September, 1847, is	$1,089,067·07	
And the amount yet to be collected from the Post Office Department and Individuals is	12,869·51	
Making, together, the sum of		$1,101,936·58
The expenses, during the same period, for working the Road and Machinery, and keeping them in repair, have been as follow, viz:		
For expenses of Transportation, including Fuel, Salaries of Superintendent, Agents, Conductors, &c.,	$197,134·40	
Repairs of the Road,	131,926·30	
Repairs of Locomotives,	74,139·51	
Repairs of Passenger Cars,	26,094·24	
Repairs of Burden Cars,	52,209·53	
Repairs of Bridges,	65,363·74	
Repairs of Depots,	16,522·72	
Repairs of Water Stations,	2,450·13	
Watching Bridges, and Pumping Water at the Water Stations,	10,111·33	
Losses by accidents—Fire, &c.,	2,955·10	
Office and Incidental Expenses, including Salaries, House Rent, Fees to Counsel, &c.,	11,921·98	
Making an aggregate of expenses of working the road and keeping it in repair, of		590,828·98
And shewing the net earnings for the year to be,		$511,107·60

J. I. Atkinson, *Treasurer.*

Office of the Baltimore and Ohio Railroad Company, 1st Oct., 1847.

(D)

The Washington Branch Railroad.

Dr.

Cost of road, real estate, engines, and cars,	$1,650,000·00
Cash in the hands of officers,	68·66
Cash on hand,	73,063·00
	$1,723,131·66

Cr.

Stock,	$1,650,000·00
Annuity account,	25,000·00
Revenue for balance of that account,	48,131·66
	$1,723,131·66

J. I. Atkinson, *Treasurer.*

Office of the Baltimore and Ohio Railroad Co., Oct. 1st, 1847.

(E)

Statement of the Revenue and Expenses of the Washington Branch of the Baltimore and Ohio Railroad, for the year ending the 30th of September, 1847.

The amount received for the transportation of Merchandize, Mails, and Passengers, for the year ending the 30th September, 1847, is		$218,418·31
And the expenses, during the same period, have been as follow, viz:		
For Bonus to the State, one fifth of the Receipts from Passengers,	$39,528·30	
Expenses of Transportation,	29,364·45	
Repairs of the Road,	18,100·36	
Repairs of Passenger Cars,	11,915·16	
Repairs of Burden Cars,	7,625·82	
Repairs of Locomotives,	10,117·46	
Repairs of Bridges,	1,908·48	
Repairs of Depots,	951·46	
Repairs of Water Stations,	423·39	
Elkridge Landing Annuity,	1,250·00	
Office and Incidental Expenses, including Salaries, House Rent, Fees to Counsel, &c.,	7,625·87	
Making an aggregate of		$128,810 75
And shewing the net earnings of this road for the year to be		$89,607·56

J. I. Atkinson, *Treasurer.*

Office of the Baltimore and Ohio Railroad Company, Oct. 1st, 1847.

Comparative Summary of the operations of the MAIN STEM *of the Baltimore and Ohio Railroad—from* 1836 *to* 1847, *inclusive.*

Fiscal Years.	FROM PASSENGERS.		FROM TONNAGE.													Aggregate of Passengers and Tonnage.
			WESTWARDLY.				EASTWARDLY.					TOTAL.				
	Passengers.	Amount.	Tons.	h.	qr.	lb.	Bbls. Flour.	T's Coal.	Tons.	h.	qr.	lb.	Tons.	h.	qr.	lb.	Amount from Tonnage.	
1836	157,102	$128,126·30	25,898	5	1	0	172,664		40,805	3	3	1	66,703	9	0	1	$153,186·23	$281,312·53
1837	140,699	145,625·29	33,901	5	3	10	113,870		40,696	4	3	5	74,597	10	2	15	155,676·09	301.301·38
1838	150,516½	166,693·53	30,079	11	1	3	142,512		47,447	7	3	24	77,526	19	1	2	198,530 79	365,224·32
1839	152,501	173,860·44	45,878	4	3	10	264,033		54,573	7	1	4	100,451	12	0	14	233,487·06	407,347·50
1840	152,418	177,035·75	25,638	10	0	9	392,449		62,736	3	1	24	88,374	13	2	8	255,847·95	432,883·70
1841	171,629½	179,615·80	23,442	13	0	19	255,818		42,056	4	3	0	65,498	17	3	19	211,454·07	391,069·87
1842	154,568	181,177·35	30,243	15	3	9	233,539		37,600	14	0	19	67,844	10	0	3	245.315·31	426,492·66
1843	149,533	274,617·27	27,191	16	3	3	266,146	4,964	55,523	11	2	20	82,715	8	1	23	300,617·81	575,235·08
1844	173,821	336,876·32	33,224	16	1	2	241,550	5,433	69,886	11	1	23	103,111	7	3	0	321.743·66	658,619·98
1845	202.458½	369,882·30	50,541	16	2	23	235,602	16,020	90,865	3	3	20	141,407	0	2	18	368,720·88	738,603·18
1846	280,264½	413,341·59	83,559	2	3	9	412,776	18,393	110,356	18	0	22	193,916	1	0	6	468,345·94	881,687·53
1847	288,674½	447,020·44	79,510	10	1	8	579,870½	50,259	183,824	8	2	18	263,334	19	0	1	651,916·14	1,101,936·58
Totals.	2,174,185½	$2,993,872·38	489,110	9	1	5	3,310,829½	95,069	836,372	0	1	5	1,325,482	9	2	10	$3,567,841·93	$6,561,714·31

W. S. WOODSIDE.

Office of Transportation,—Baltimore and Ohio Railroad Co., 4th October, 1847.

High Pressure Steam.

The greatest object remaining to be accomplished in navigating the ocean by steam, is unquestionably the *saving of fuel*, and this, to any great extent, can only be effected by using high-pressure steam expansively, by which not only *one-half* of the tonnage occupied at least will be liberated, but *one-half* the cost of the fuel will be saved. We need not expatiate upon the immense importance of such a reduction, both to the naval and commercial marine of this country, particularly where distant depôts have to be so frequently replenished, because that can be duly appreciated by every person practically experienced in steam navigation. But no sooner, however, is the proposition mooted, than a fierce fusilade is opened against so dangerous an innovation, which that is presumed to be,—as if any inherent property existed to render high-pressure steam more dangerous or destructive than steam of low-pressure. This, however, results from prejudice rather than from calm and dispassionate reasoning; in the face, too, of daily experience and the successful operation of hundreds of locomotives gliding over our iron roads at something like 60 miles an hour, notwithstanding the very high power employed, which marine purposes do not require,—that it is really gratifying to read your judicious and pertinent remarks in the case of the late explosion of the Cricket steamboat.

With properly constructed safety-valves, to limit the pressure with certainty, placed beyond the control of the engineman or driver (which is a matter of equal importance in both systems), high steam will prove as safe, nay safer than low-pressure, if generated in suitable boilers; which, we trust, we shall be able to show. We are not aware if there exists any collected record of the number of explosions which have occurred, distinguishing the class to which each belongs, together with the probable cause and circumstances attending them, beyond the transitory and imperfect accounts given in the news of the day; or we believe it would be found, that not only are the most destructive effects produced, but also that two-thirds, possibly three-fourths, are occasioned by low-pressure steam, or by boilers so denominated (see the frightful account of the explosion in the newspapers of to-day—October the 7th—as detailed before the coroner at Leeds). And what would have been the consequence if many low-pressure marine boilers had been subjected to the fool-hardy and reckless treatment practised on board the "Cricket?" Would they have resisted one-half the time those boilers did?—we presume to think not.

Marine boilers of the usual form of construction and magnitude are the worst to resist pressure; and, therefore, in examining the comparative safety of the two systems, we will assume that the boilers are of the same form—viz.: cylindrical (where the tension of the metal is most perfectly applied), and the pressure in one to be four pounds the square inch, and that of the other to be fifty, while the thickness of metal in each shall be in the exact ratio to the strain: thus, multi-

ply the pressure by the radius, and divide the sum by 400 (equal to one-tenth of the strength of the plate for every eighth of its thickness), and the quotient will express the thickness in eighths which the plates of each of the boilers should contain.

Thus, we have two boilers whose power of resistance in relation to their contents are exactly equal; hence, if the fifty pounds steam were to be doubled, the pressure would not be one iota more dangerous than the four pounds steam being increased to eight, and *vice versa*; consequently, in relation to strength, one boiler is as likely to explode as the other: but as neither is likely to take a flight if duly supplied with water, and their safety valves be in good order, we will proceed to consider the result in case of neglect—first, with regard to a deficiency in water, and next to the valves becoming fixed. With respect to a deficient supply of water, the chance of an explosion would probably be pretty nearly equal, and so would be the force, from the larger volume necessarily pent up in low-pressure boilers; indeed, we are not aware that there is any distinction observed in this particular, but in effect the low steam may be assumed to be more disastrous from its scalding property, as you very properly remark, than high-pressure. In respect to the safety valves, we have shown that each boiler is capable of resisting the doubling of the working pressure of its contents, or any other extent in the same ratio, in an equal degree. Now, it is quite possible for a low-pressure valve to adhere to its seat so firmly as to resist the additional four pounds per inch, and even a much greater increase, ere an explosion ensue; but for a valve of a high-pressure boiler to resist an addition of fifty pounds per inch without being unseated, is scarcely within the bounds of probability. All boilers require careful and efficient superintendence most unquestionably, and casualties from neglect will sometimes occur without doubt; but under an equal degree of supervision and skill in construction, we think we are justified in the conclusion that high-pressure steam in regard to safety has the advantage.

The quantity of fuel saved depends upon the just application of the expansive principle; the usual practice is for the pressure in the boiler to be *constant*, and the amount of expansion varied by expansive gear, according to the exigencies of the service. To prove that this is an error, we have only to imagine a cylinder, say four inches long and one in diameter, with steam of four pounds cut off at one quarter its length and allowed to expand to four times its volume, which will exert a mean force of two pounds and a fraction; this we will assume to be the minimum working power of the engine. Now, if circumstances require the maximum power to be applied of four pounds during the whole stroke, it is manifest that a *four fold* amount of steam will be required, and expansion must be abandoned altogether to effect it when its saving effect is most requisite, as the largest amount of fuel is being consumed. Now, if we reverse these functions, by making the amount of expansion *constant*, and work with a *variable* pressure, it will be found that the steam required will be exactly in the ratio of the work done; thus, if we raise the pressure to *eight pounds*, and cut off the steam as before, we obtain a mean

of over four pounds, with just double the quantity of steam, instead of quadruple as above, and of course at one-half the expense of fuel. The pressures here assumed for illustrating the two modes of application are not those, of course, which would be adopted in practice, but the result would be the same in effect if the maximum pressure were sixty-five pounds above vacuum, and the minimum one-half that amount, working with a constant expansion of eight or ten times its original volume.

Now that competition is so strong in rates of speed, every degree of pressure is employed and steam generated in all kinds of boilers, suitable or unsuitable; the temptation is so great to run dangerous risks for the sake of victory, that some power of control is become absolutely necessary—a matter, however, of no very difficult accomplishment, though it might be opposed by the proprietors, possibly, as exposing the secret of the doings in the engine-room, with regard to the real working pressure; but that is a matter of no weight, nor can it be honestly objected to or denied. We would suggest, then, that a competent person should have the power to inspect *all steamboats*, periodically, as to the fitness and condition of the boilers in relation to their working pressure, and to see the following precautionary checks adopted—viz.: One safety-valve, at least, on each boiler, placed beyond the control of the engineer, except as to having the power of lifting it occasionally, to insure its duly operating: or by a slight easement effected at regular intervals by the engine itself, but no power of adding weight. Next, that two graduated gauges be fixed in one case above deck; one showing the pressure of steam in the boilers, and the other the level of the water and the excess or deficiency in either case from the fixed working points on the scale.—These gauges to be open at all times for inspection to every person on board, and minutes made in the log at regular intervals in sea-going steamers, particularly during the night, stating the height of the water and pressure of steam. The sound working condition of these gauges to be maintained at all times, and cases of neglect, or tampering with them in any manner, to be visited by a severe fine—perhaps fine and imprisonment, where so many lives are endangered, which would at once put an end to the reckless tampering with the pressure, and insure careful attention to the supply of water, and consequently safety to all on board. C.

London, October 7, 1847. Civ. Eng. & Arch. Journ.

New Steam Gauge.

The following letter has been addressed to a morning paper:—Sir, A most important invention has been submitted to me for my approval, patented by a Mr. Smith, of Nottingham, and is intended to indicate the strength of steam in steam engine boilers; it is particularly adapted for steamboats, and can be placed in the cabin, on deck, or on any other part of the vessel, where it may be seen by every passenger on board. It may also be fixed in the office of every manu-

factory where a steam engine is used, at a considerable distance from the boiler. I am so much pleased with it, that I have put one up at one of my own collieries; it is some distance from the boiler, and in another house, and works most beautifully, showing the rise and fall of the steam in the most delicate manner. The indicator is like the face of a clock, with a pointer, making one revolution in measuring from 1 lb. to 100 lbs. upon the square inch of the pressure of steam; it is quite from under the control of the engineer, or any other person, so that its indications may be relied upon, and the construction is so simple that it is scarcely possible for it to get out of order. I might give a full explanation of the machine, but I think it best to leave that to the inventor himself. The numerous and appalling accidents which have occurred from the bursting of steamboat boilers have induced me to give you these observations, which I think desirable to be laid before the public. I may state that I have no pecuniary interest in the scheme; but being the first person to whom it has been shown, and the first to make use of it, I feel it a duty that I owe to the inventor, as well as the public, to make it as universally known as possible. The indicator is put up at Tapton Colliery, near Chesterfield; and may be seen any day by any respectable person by inquiring either for Mr. Hindmarsh or Mr. Langlands.

GEORGE STEPHENSON.

Tapton-house, Chesterfield. London Athenæum.

AMERICAN PATENTS.

List of American Patents which issued in the month of September, 1846,—with Exemplifications, by CHARLES M. KELLER, *Agent for procuring Patents, and late Chief Examiner of Patents in the U. S. Patent Office.*

1. For *Improvements in the Adjustable Clevis for Ploughs;* Samuel Wilt, Hagerstown, Maryland, September 3.

The patentee says,—"Many modifications of the clevis have been made, by which the plough was to be properly set, but heretofore generally without success, and in many instances the expense of construction was so great that they were not brought into general use By my newly-invented clevis, I am enabled to set the draught up, or down, or sideways, with the utmost exactness, which has not been attained by any clevis now in use."

Claim.—"Having thus fully described my invention, I wish it to be understood that I do not claim adjusting the height of the draught by a screw, nor do I claim regulating the clevis by a slit and set screw, as these have before been done; but what I do claim as my improvement, and desire to secure by letters patent, is the combination of the horizontal and vertical adjusting apparatus, constructed as herein described; by which the adjustment can be made either way with the minutest exactness."

2. For *Improvements in Stump Extractors;* John R. Remington, Lowndes county, Alabama, September 3.

The patentee says,—"The nature of my invention consists in the combination of levers, so arranged as to divide the downward pressure on to two fulcrums instead of one, to shorten the levers and increase their effect, while the whole apparatus is made portable, and can be conveniently transferred from one point to another."

Claim.—"Having thus fully described my improvement, what I claim as my invention, and desire to secure by letters patent, is the combination of levers, as described, constructed and operating substantially in the manner and for the purpose set forth."

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3. For *Improvements in Stoves for Warming Rooms, &c.;* Oliver S. Hartshorn, Henry M. Payson, and Aaron Ring, Portland, Maine, September 3.

Claim.—"The parts of this stove which we claim as our own invention, and desire to secure by the patent to be issued on these specifications, and the drawings accompanying, are the combination of the common wood stove and cylinder coal stove, in the manner described, so that coal may be burnt alone, and the draught so arranged, as specified, as at the same time to heat the wood stove with the same heat; and if wood alone should be burnt, then the draught may be so managed and arranged, as specified, as at the same time to heat the radiator and coal cylinder; and in this case the draught may go from the coal cylinder through the funnel at the top, or that funnel may be closed, and the front of the ash-pit closed, and the funnel from the ash-pit opened, which will give much more heat than to carry the draught off at the top of the coal funnel."

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4. For *Improvements in the Yoke for Yoking Oxen;* David Chappel, Sheldon, Franklin county, Vermont, September 3.

We are under the necessity of omitting the claims, as they refer to, and are dependent on, the drawings. The first section is limited to the use of a sliding block, through which the yoke passes, and which moves on the beam. The second is limited to the use of a movable regulator, attached, by a bolt, on the top of the yoke, and in combination therewith a gauge to be placed on the top of the bows.

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5. For *Improvements in the Machine for Mowing and Reaping Grain, Grass, &c.;* Alexander M. Wilson, New York, September 3.

The patentee says,—"My improvements consist, first, in making the cutting edges of the cutters of a more gradual curve, and rounding off the heel, so as to continue cutting as the machine approaches the uncut grain, or grass, to avoid throwing too much work on the heel part of the cutters, and, at the same time, to bring into action a greater extent of cutting surface for a given size of wheel than could possibly

be attained by the previous mode. Secondly, the cutting and gathering wheel has its bearings in the main frame of the machine; and the horses are harnessed to a frame which is jointed to the forward part of the main frame, but back of the centre of the cutting wheel, and extending diagonally to the side, so that the horses are in the swath previously cut, and pass over the irregularities of the surface, leaving the cutters free to follow the undulating surface. Thirdly, I connect the drum of the cutting and gathering wheel to its shaft by means of curved or dished arms, and bend the runners up within the drum, to receive guide-wheels to adapt the cutters to the inequalities of the surface of the ground, instead of relying entirely on the friction of the runners. And, fourthly, I grind the upper beveled edges of the cutters by means of a horizontal rotating grinder, the under surface of which is beveled to the inclination of the beveled faces of the cutters, and combine this with a permanent grinder, over which the cutters pass, to remove the wire edges produced by the rotating grinder."

Claim.—"1st. What I claim as my invention, and desire to secure by letters patent, is making the heel of the cutters rounded when a number of cutters are combined together on a wheel, to cut grass, or grain, by the rotation and forward movement of the machine, as herein described.

"2d. I claim jointing the horse frame to the forward part of the main frame, but back of the shaft of the cutting wheel, so as to have the horses placed forward and to the side of the cutters, in combination with a wheel of cutters for cutting grain, or grass, so that the cutters may follow the undulations of the ground independent of, and not affected by, the up and down movement of the horse, as herein described."

"3d. I claim the employment of the guide-wheels, in combination with the cutting and gathering wheel, connected with its shaft by means of curved or dished arms, as herein described.

"4th. I claim, in combination with the curved cutters attached to and forming the cutting wheel, the rotating grinding wheel, for grinding the upper beveled face of the cutters, as described; and, finally, I claim, in combination with this, the grinder for grinding the under surface of the cutters, as described."

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6. For an *Improvement in the Method of Separating the Oleic from the Stearic Acid, in the Manufacture of Candles;* Jas. S. Gwynne, Pittsburg, Pennsylvania, September 3.

Claim.—"What I claim as new, and desire to secure by letters patent, is the application of heat, through a liquid or aeriform medium, to the mass to be pressed, in such a manner that the said mass, before it is subjected to pressure, shall be heated gradually and uniformly throughout to such a degree that while the stearic acid is at no time during the process melted, the oleic acid is rendered fluid enough to be afterwards expressed, in the manner described."

7. For an *Improved Machine for Hulling Rice, Coffee, &c.;* Clark Jacobs, Brooklyn, New York, September 3.

The patentee says,—"The nature of my invention consists in the combination of a conical runner stone with a stationary stone and case, so that the two stones should, by their action, break the hulls of the grain passed between them, and the side case finish the operation of purling."

Claim.—"Having thus fully described my improved machine, what I claim therein as new, and desire to secure by letters patent, is the combination of the stationary stone and the side casing with the conical runner, in the manner and for the purpose set forth."

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8. For an *Improved Sash Fastener;* James Jones, Rochester, New York, September 3.

Claim.—"Having thus fully described the manner in which I construct and use my sash fastener, what I claim as new therein, and desire to secure by letters patent, is the employment or use of the catch, with its hooked end, in combination with the plate, with its mortise, for the purpose of holding the lower sash securely down; the whole being formed, arranged, and combined substantially as set forth."

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9. For *Improvements in the Machinery for preparing the "Blanks" in the Manufacture of Wood Screws;* Thomas W. Harvey, New York, September 3.

The patentee says,—"In my machine for cutting off the wires and for forming the heads thereon, preparatory to the other operations necessary to the perfecting of wood screws, the wire is fed into the machine from two coils, from each of which a wire is alternately cut and headed by the two cutters and one heading punch—the feeding in of one wire being in progress whilst the head is being formed on that previously fed in, an arrangement by which much time is saved, and the heading is more effectively performed."

Claim.—"Having thus fully described the manner in which I construct my machine for preparing the blanks for the formation of wood screws, and which may also be applied to the forming of rivets, and other articles of a like nature, what I claim therein as new, and desire to secure by letters patent, is the manner, herein set forth, of producing the respective alternating motions necessary to the double feeding, by combining the respective arms with the cams, having grooves crossing each other, said cams carrying swiveling cam pins, and operating the rock shafts, which shafts are connected with the respective operating parts of the machine, with the exception of the heading die, substantially in the manner made known. And this I claim, whether said motions be effected by one or more cams of the kind described, whilst the operating parts are substantially the same in their arrangement and action with those described and delineated.

"I also claim the arrangement and combination with the cams and

with the respective rock shafts and single heading punch of the double acting apparatus, consisting of the feeding wheels and segments, the cutters, the gripping tumblers, and the sliding die-holder; the whole being made to operate substantially as described."

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10. For an *Improvement in the Self-setting Tail-block for Saw Mills;* Horace Merrell, Wheatland, Monroe county, New York, September 3.

Claim.—"Now what I claim as my invention, or discovery, is the application of the vibrating rack, together with the movable cogs and the movable racks, as described, connected to the mill floor, or timbers, in combination with the lever, wheel, and other appendages, in the manner described."

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11. For an *Improved Machine for Fencing and Ditching at one and the same operation;* William C. Bussey, Rockgrove, Illinois, September 3.

The patentee says,—"By my machine, two ditches are cut parallel to each other, and a mound, or ridge, of earth raised between them, all perfectly sodded, and more compact than by the old method."

Claim.—"Having thus fully described my machine and its mode of operation, what I claim therein as new, and desire to secure by letters patent, is the combination of two ditching machines, in the manner described, so that the sods cut from two parallel ditches shall be elevated and placed, with the grass, out in a continuous ridge between said ditches at one operation, in the manner and for the purpose set forth."

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12. For an *Improvement in the Machine for Breaking Hemp, &c.;* Thos. L. Fortune, Liberty, Clay county, Missouri, September 3.

Claim.—"Having thus fully described my improved brake, what I claim as my invention, and desire to secure by letters patent, is constructing the brake in the manner described, by curving the swords of the brake convexly from end to end, placing the centre swords higher than the outside ones, as fully set forth."

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13. For an *Improved Instrument for taking Measures for Garments;* William R. Acton, Fewcastle, Botetourt county, Virginia, September 5.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the constructing a tailor's measuring instrument by the combination of the elastic metallic plates, self-registering scale straps, and the upper and lower knobs, or pivots, substantially in the manner and for the purpose set forth.

"I also claim the manner of taking the requisite measures for the formation of a coat, by my self-registering instrument, and the com-

bination therewith of a tape measure, with a ring, or loop, at one of its ends, substantially as set forth."

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14. For an *Improved Mode of Drawing Wagons, Sleighs, &c.;* Mylo Knapp, Springwater, Livingston county, New York, September 5.

The patentee says,—"The nature of my invention consists in transferring a portion of the load to the collars of horses, or the yokes of oxen, only in the act of drawing."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the lever, roller strap, rollers, clasp, and guard, to be applied to the tongues and shafts of carriages, to produce a proportionate bearing, as described."

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15. For an *Improvement in the Mode of Heating Rooms;* John H. B. Latrobe, Baltimore, Maryland, September 5

Claim.—"What I claim as new, and desire to secure by letters patent, is the employment of a stove, such as described, so constructed and placed within the ordinary fireplace as to heat the room by its direct radiation, as well as by heating air entering the room from the outside as described, serving the double purpose of a stove and hot air furnace."

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16. For an *Improvement in the Plough for Ploughing Corn, Potatoes, &c.;* John Krauzer & Cyrus Krauzer, Reading, Berks county, Pennsylvania, September 5.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is, first, the knee, or brace, cast on the stand, as explained. Second, the longitudinal openings, together with the metallic boxes."

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17. For an *Improvement in Railroad Trucks;* John F. Rodgers, Troy, Rensselaer county, New York, September 5.

Claim.—"Having thus fully described my improved truck, I wish it to be understood that I am aware that trucks have been formed with a single cross, or centre bar, and in such a way as to allow any one of the wheels to rise and fall, as in my construction; but they have all lacked the strength of connexion to render them available, and their expense has been such as to prevent their use; therefore, what I claim as my invention, and desire to secure by letters patent, is the combination of the balance beam with the centre beam, substantially in the manner set forth, by means of the recesses in the centre beam spring plates, having tubes thereon, as described, on which the springs rest, and attached to the beam by bolts, by which a compact and secure connexion is formed, while all the necessary flexibility is preserved."

18. For an *Improvement in Straw Cutters;* G. Catchpole, Geneva, Ontario county, New York, September 5.

Claim.—"Having thus fully described my improvements, what I claim as new therein, and desire to secure by letters patent, is, first, the combination of the sliding gate, front block attached thereto in a stationary manner, and top roller, in the manner described; the said plate sliding in grooves in the outside plates of the frame, by which it is steadied and directed.

"Secondly, I claim constructing the rollers, as described, so that the top roller gathers in faster than the bottom, to prevent clogging, in the manner set forth."

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19. For an *Improvement in Windlass, and other Bedsteads;* Joseph W. Adams, (assignor to Simon H. Lewis & J. C. Clapp,) Boston, Massachusetts, September 10.

The patentee says,—"The great objections which have been met with in the use of windlass bedsteads, as they now are, and have been heretofore, constructed, are, that as the sacking has been merely tacked, or nailed, to the side swell beams, the fabric is liable to break away from the nails, or tacks; and when, for this reason, and for the loosening of the cords which confine the sacking to the end swell beams, or for other reasons, the said sacking becomes loose or slack, the whole frame-work of the bedstead becomes 'ricketty,' so to speak. My improvements are designed to remedy these objections, and consist in a new mechanical arrangement for securing the sacking to the side beams, and a simple additional fastening for securing, more perfectly, the two *side* and two end beams, at their ends, to, or in, the mortises of the upright corner posts of the bedstead."

Claim.—"Having thus described my improvements in windlass, and other bedsteads, I shall state my claim as follows: What I claim as my invention, and desire to have secured to me by letters patent, is the mode, herein above described, (or any other mode substantially the same,) of inserting the confining pins, at the four corners of the bedstead frame, so that when the keys are driven into the holes in the ends of said pins, the strain on the frame all around shall be in the same horizontal plane."

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20. For a *New and Improved Cooking Stove;* William H. Allen, Wellsburg, Virginia, and James Slocum, Brownsville, Pennsylvania, September 10.

The patentees say,—"The nature of our invention consists in constructing a cooking stove in such a manner as that it can be readily changed from a wood to a coal stove, by removing a movable ash-pit hearth, and placing a grate and fire-plates in the front part of the stove, as described."

Claim.—"Having thus fully described our improved cooking stove, what we claim therein as new, and desire to secure by letters patent,

is the manner in which we convert a single oven coal stove into a double oven wood stove, by the withdrawal of the grate, and the insertion of the movable ash-pit hearth, arranged, combined, and operating with the air-chamber, or flue-space, substantially as set forth."

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21. For a *Machine for Sewing Seams in Cloths or other articles requiring to be sewed;* Elias Howe, Jr., Cambridge, Middlesex county, Massachusetts, September 10.

The patentee says,—"In sewing a seam with my machine two threads are employed, one of which threads is carried through the cloth by means of a curved needle, the pointed end of which is to pass through said cloth; the needle used has the eye that is to receive the thread within a small distance, say an eighth of an inch, of its inner or pointed end. The other or outer end of the needle is held by an arm that vibrates on a pivot or joint pin, and the curvature of the needle is such as to correspond with the length of the arm as its radius. When the thread is carried through the cloth, which may be done to the distance of about three-fourths of an inch, the thread will be stretched above the curved needle, something in the manner of a bowstring, leaving a small open space between the two. A small shuttle, carrying a bobbin filled with silk or thread, is then made to pass entirely through this open space, between the needle and the thread which it carries; and when the shuttle is returned, which is done by means of a picker staff or shuttle-driver, the thread which was carried in by the needle is surrounded by that received from the shuttle; and as the needle is drawn out, it forces that which was received from the shuttle into the body of the cloth: and, as this operation is repeated, a seam is formed which has on each side of the cloth the same appearance as that given by stitching; with this peculiarity, that the thread shown on one side of the cloth is exclusively that which was given out by the needle, and the thread seen on the other side is exclusively that which was given out by the shuttle. It will, therefore, be seen that a stitch is made at every back and forth movement of the shuttle. The two thicknesses of cloth that are to be sewed are held upon pointed wires, which project out from a metallic plate, like the teeth of a comb, but at a considerable distance from each other—say three-fourths of an inch, more or less; these pointed wires sustaining the cloth, and answering the purpose of ordinary basting. The metallic plate from which these wires project has numerous holes through it, which answer the purpose of rack-teeth in enabling the plate to be moved forward, by means of a pinion, as the stitches are taken. The distance to which said plate is moved, and consequently the length of the stitches, may be regulated at pleasure."

Claim.—"Having thus fully described the manner in which I construct my machine for sewing seams, and shown the operation thereof, what I claim therein as new, and desire to secure by letters patent, is, first, the forming of the seam, by carrying a thread through the cloth by means of a curved needle on the end of a vibrating arm,

and the passing of a shuttle furnished with its bobbin, in the manner set forth, between the needle and the thread which it carries, under a combination and arrangement of parts substantially the same with that described.

"I also claim the lifting of the thread that passes through the needle eye by means of the lifting rod, for the purpose of forming a loop of loose thread that is to be subsequently drawn in by the passage of the shuttle, as herein fully described; said lifting rod being furnished with a lifting pin, and governed in its motions by the guide pieces and other devices, arranged and operating substantially as described.

"I claim the holding of the thread that is given out by the shuttle so as to prevent its unwinding from the shuttle bobbin after the shuttle has passed through the loop, said thread being held by means of the lever or clipping piece, as herein made known, or in any other manner that is substantially the same in its operation and result.

"I claim the manner of arranging and combining the small lever with the sliding box, in combination with the spring piece, for the purpose of tightening the stitch as the needle is retracted, as described.

"I claim the holding of the cloth to be sewn by the use of a baster-plate, furnished with points for that purpose, and with holes, enabling it to operate as a rack in the manner set forth, thereby carrying the cloth forward, and dispensing altogether with the necessity of basting the parts together."

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22. For a *Machine for Excavating and Embanking Ditches;* Samuel Thrailkill, LaFayette, Indiana, September 10.

The patentee says,—"My first improvement consists in connecting the mould board, or winding trough which carries up the earth and delivers it on the side of the ditch to form the embankment, with the share, by means of a hinged joint, so that this part of the machine can be elevated or depressed to adapt it to the forming of any depth of ditch. My second improvement consists in adapting to the forward part of the board which carries the forward end of the side cutters that form the side of the ditch, two rollers or wheels, the axles of which are hung in vibrating frames, each connected by a stirrup with a screw that is tapped, through an arber that turns in standards, so that by the turning of the screws the rollers can be elevated or depressed at pleasure, to increase or decrease the depth of the ditch. And my third improvement consists in making the cutting edges of the two inclined side cutters with offsets or teeth to increase their capacity for cutting."

Claim.—"I claim, in combination with the adjustable mould board, adjusting the depth of the forward part of the machine, substantially as described."

23. For an *Improved Spark Arrester;* Augustus Hamann, Washington, District of Columbia, September 10.

Claim.—"Having thus fully described my improved apparatus, what I claim therein as new, and desire to secure by letters patent, is the combination of the pipes *c* and E, the box *i*, and pipe *n*, constructed substantially in the manner and for the purpose herein fully set forth, so as to cause a sufficient draught, and at the same time to arrest the sparks."

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24. For an *Improved manner of Manufacturing Artificial Burr Stones;* Ezekiel Cutter and Stephen Blanchard, Cincinnati, Ohio, September 10.

Claim.—"Having thus fully set forth the nature of our new manufacture of artificial burr millstones, and shown the manner in which we effect the same, what we claim therein as new, and desire to secure by letters patent, is the preparing of such artificial burr stones, by incorporating with clay, or such earth as is fitted for making the harder kinds of pottery, a large portion of fragmentary vegetables, or such other suitable matter as will cause the said clays, when burnt, to be filled with pores of the kind by which it is adapted to take the place of the natural burr stone; the whole procedure and operation being substantially the same with that herein fully made known."

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25. For an *Improved mode of Curing Meat in Vacuum;* Augustus C. Allen, Houston, Texas, September 10.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the mode by which I obtain a vacuum in meat vat A, for curing meat, by exhausting the brine from meat vat A, into brine vat B, and by means of the combination of stop-cock P and pipe K, connecting vat A with vat B, and stop-cock L, in pipe N, I, substantially as above described."

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26. For an *Improved mode of forming a Grinding Surface in Mills;* Jesse Fitzgerald, New York, September 12.

Claim.—"Now what I claim as my invention, and wish to secure by letters patent, is the use of French burr stones, or of a similar material, not in blocks, but in small pieces, heretofore considered useless, and setting these pieces in an external frame, of the shape of a cone or cylinder, so as to form a grinding surface that will cost far less than a similar surface formed in any other way hitherto employed."

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27. For an *Improvement in Printing Presses;* William W. Marston, New York, September 12.

Claim.—"I do not claim the invention of printing by machiner

those necessary parts common to printing machines, taken in connexion with the parts substituted by me for others necessary to make one machine; but what I do claim as my invention, and desire to secure by letters patent, is the use of a vibrating cylinder or cylindrical segment having two sets of grippers, constructed as described; also, the application of revolving cylindric brushes in the manner described; and, finally, the use of adjustable weights in connexion with the vibrating cylinder or segment; the whole being constructed, combined, and operating substantially in the manner set forth."

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28. For an *Improved Balance for Weighing;* Joshua Gibbs, Newark, Ohio, September 12.

The patentee says,—"The nature of my improvement consists in the manner in which I have attached the scale beam to the platform balance, so that it can be turned in any horizontal position to weigh with."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is combining the scale beam with the platform balance, in the manner described, so as to be turned into any horizontal position, the whole being constructed as herein set forth."

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29. For a *Machine for Scouring and Dusting Mill Feed after Bolting;* Edward Bradfield, Rochester, New York, September 15.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is constructing the inside cylinder with a combination of cards and hair brushes; also, in combination with the above, the flat screen, the double separator, the spring beater, and the manner in which the outside cylinder revolves on the cylindrical journals, without coming in contact with the shaft; all as herein set forth, for the purpose herein described."

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30. For an *Improvement in the Manner of Constructing a Coffer Dam;* Sam'l S. Walley, Charlestown, Pennsylvania, September 12.

Claim.—"Having thus fully described the manner in which I construct and employ my portable coffer dam, what I claim therein as new, and desire to secure by letters patent, is the manner in which I have arranged and combined the respective parts thereof, so as to adapt it to the purpose intended as herein made known; that is to say, I claim in combination the providing of the inner box or coffer with doors at its lower part, which, when closed, will convert it into a buoyant vessel, said coffer being provided with elastic padding on its lower edge, and troughs or boxes capable of receiving such load of stone, or other materials as will sink, and press the coffer down upon the bottom of the stream or other water, as herein fully made known, and the expedient of letting in the water to fill the said boxes to increase the pressure, and the pumping out of said water to render it more buoyant."

31. For an *Improved Self-cleaning Blacksmith's Forge or Furnace;* James R. Hobbs, Huntsville, Alabama, September 15.

The patentee says,—"The nature of my invention consists in constructing a blacksmith's furnace in such a manner that the fire chamber will keep itself perfectly clear of ashes and cinders, and in so arranging the grating and furnace that the atmosphere shall circulate through and around them in such a manner as to regulate their temperature, and prevent their being injured or destroyed by intense heat."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the introduction of a blacksmith's furnace in such a manner as to allow the cinders and ashes to freely escape, and prevent their clogging the fire chambers, by placing grate bars at its base, opening into an open air chamber, (leading out at the side of the forge,) and the admitting the blast through the sides of the fire chamber above the top of the grate bars, substantially as herein set forth."

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32. For an *Improvement in Steelyards;* Thaddeus Fairbanks, St. Johnsbury, Vermont, September 15.

Claim.—"My improvement, and therefore that which I claim, consists in the auxiliary scale and weight, as combined and operating with the main weight, substantially in the manner and for the purpose as above specified."

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33. For an *Improved Corn Plough and Cultivator;* Isaac Edwards, Orange county, Indiana, September 19.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner of combining the hooks, and eyes, and clevis, as described, by which the sides of the plough may be elevated and raised out of the ground, so as to conform to the inequalities and irregularities in the corn rows, without disturbing the other parts of the machine, and without the necessity of raising the entire plough."

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34. For an *Improvement in the Bee Hive;* William Whitcomb, Grafton, Vermont, September 19.

The patentee says,—"The peculiar nature of my improvement consists in the manner in which I have arranged the cases of the drawers of the hive in the same; the said arrangement, very simple as it may appear, enabling me to obtain very great advantages in the management and operations of the bees."

Claim.—"I do not claim the employment (in a hive) of drawers and boxes, and cases to receive them, as I am well aware that such are old and common devices; but that which I do claim, is my improved manner of arranging each box, and its case in the main chamber of the hive, as described; that is to say, the so disposing them therein, that two diagonal flues, passing through their corners, shall be re-

spectively parallel to the bottom and sides of the hive, substantially as specified."

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35. For an *Improved Projectile, for Killing Whales or other Fish;* Oliver Allen, Norwich, Connecticut, September 19.

Claim.—"Having thus described my invention, I shall claim the lance head, the cylindrical barrel, or bomb, and the priming tube, in combination with one another, and arranged and operating together substantially as set forth."

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36. For an *Improved Reciprocating Steam Engine;* Daniel Barnum, New York, September 19.

The inventor says he has "invented and made certain new and useful improvements in the mechanical arrangement, construction, application, and combination of the parts of steam engines that are intended to work by the action of steam, admitted into one cylinder at a given pressure, and in the progress of the stroke, or half-revolution, the communication with the boiler is cut off, and the steam is allowed to pass into a second cylinder and work expansively, which has been done before by others, but not in the manner invented by me, the first difference between my hereinafter described invention, and nearly all that have preceded it, being that I use two parallel and equal-sized cylinders, set along side of each other. The second difference is, that with these two cylinders, I use only one induction steam pipe from the boiler, and one eduction pipe from the cylinders to the atmosphere, or a condenser. The third difference is, that the steam is admitted by a proper induction valve, to about the half length of the first cylinder; the induction valve is then closed, and an expansion valve simultaneously opened from the first to the second cylinder. Thus the operation of the steam, commencing at the same end of both cylinders, forms the fourth difference between my plans and those of others, and the expansion valve is sustained open, so that the steam shall act expansively during the remainder travel of the first piston, and shall also propel the pistons both in the same direction, during a large portion of the travel, or stroke, of each, without reacting from one piston upon the other, which constitutes a fifth difference between this invention and others which have preceded it. The exhaust valves operate to exhaust both cylinders to the air, or to a condenser, at the same time, from the same end of each cylinder to the same said pipe, and this constitutes a sixth difference between this and other plans preceding it; a large portion of these ends being attained by placing the piston rods in connexion with two cranks on one main or driving shaft; which two cranks are to be placed either at right angles, or at some acute or lessening angle, less than ninety degrees apart, which is believed to be the seventh clear and distinct difference between these arrangements and any that have preceded them. It is well known that double engines have been made to act with either equal or unequal cylinders, upon cranks set at opposite points in the same

line, with valves and openings that pass the steam from the top of the first piston to the bottom of the second, and *vice versa ;* and three-fold engines, having cranks more than ninety degrees apart, have been used; and marine engines, with cranks set at ninety degrees apart, each operated by a separate and unconnected cylinder, are in common use; yet no one of these operates in the manner herein proposed ; the nearest approach to which has been made with two cylinders and pistons operating on a pair of right-angled cranks, the valves set to admit the steam from the boiler only when the first crank had passed upwards or downwards to an angle of forty-five degrees, and at one hundred and thirty-five degrees passing the steam expansively from the first to the second cylinder, to the end of the stroke of the first piston, and thus making the second piston carry the first crank past the dead centres, each piston traveling without steam operating on it during the first quarter of each stroke. All these and many other modifications of steam engines, for the same end, are variant from my invention and improvements, by not acting in so direct concert to produce an expansive, direct, and continuous action of the steam in the same direction, or both pistons through the relative positions of the cylinders and cranks, and the arrangement and combination of the acting parts."

Claim.—"Having, in the commencement of this specification, set forth the general differences between these arrangements, and those that have preceded them, it will be understood that I do not claim to have originally invented an expansively acting steam engine ; neither do I claim to have invented any of the parts herein described, as used by me for these purposes, the whole of them having been long well known and in general use; neither do I claim the application of two cylinders with a pair of cranks irrespective of an arrangement for the admission of the steam from the first cylinder into the second at the half stroke (more or less) of the first piston; but I do claim as new, and of my own invention, and desire to secure by letters patent—

"First. The mode of constructing and arranging two steam cylinders, side by side, with steam passages from one to the other direct, at each end, in combination with valves so arranged and operated as to admit the steam from the boiler into one cylinder only, and from that one into the same end of the other cylinder at the half stroke (more or less) of the piston of the first cylinder, substantially as described and shown.

"Second. I claim as new the mode of working the expansion and exhaust valves, contradistinguished from the working of all other valves, they each being opened by the toe of one rock-shaft, in advance of the regular, or usual, period; the one, at the proper time to allow the steam to pass into the second cylinder, to act by expansion, and the other, at the proper time to prevent the compression of steam, or reaction between the two pistons; from which toes the valves are each taken by a toe of another rock-shaft, for the purpose of being sustained, and kept open, the requisite length of time for the attainment of the ends sought, as described and shown.

"Third. I claim as new the arrangement for disconnecting the two

cylinders, by simply opening the exhaust valves to the second cylinder, and unhooking the eccentric which works the expansion valves between the two cylinders, where the first cylinder is used, as a single engine, worked in the ordinary way or by hand, for the purpose of reversing the motion, or stopping, or starting, the engine, as described and shown.

"Fourth, and lastly. I claim the arrangement and application of the several parts with each other which I have above described and set out as new; in combination with a pair of cranks which are attached to one main, or driving shaft, set to a right angle, or either more or less than a right angle, with each other, for the purpose of working the pistons of the two cylinders in the same direction by the primary and expansive action of the steam, and exhausting to the air, or a condenser, forming a vacuum, each working by one channel from the same end of the two cylinders at the same time, substantially as described and shown."

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37. For an *Improvement in the Machine for Cutting Straw;* Isaac Mayfield, Elkton, Kentucky, September 19.

The patentee says,—"The nature of my invention and improvement consists in compressing the article to be cut at the mouth of the box, at the moment of cutting, or descent of the knives, by means of a presser of a prismoidal shape, caused to move in the arc of a circle by mechanical means; said presser being attached to a horizontal transverse bar, by rods, said bar having two parallel arms moving on centres, or pins, attached to a vertically sliding frame containing the bearings of the feed roller; said bar, to which the presser is attached, and into which said arms are inserted, being caused to move in the arc of a circle, by means of a rod, or sweep, attached to it and to the top of a vertical lever, that has a vibratory movement on a bolt, or pin, inserted into the side of the cutting-box; the lower end of said lever being connected by a rod, to one end of a horizontal vibrating lever that turns on a vertical bolt at the rear end of the cutting-box, the other end of said lever having a vertical pin, or cog, which enters a serpentine groove made in the periphery of a revolving cylinder fixed on the end of a horizontal crank shaft, to which the revolving cutting wheel is affixed."

Claim.—"From the foregoing description, it will be seen that the motions of feeding and pressing are not only positive, (effected by the motion of the serpentine grooved wheel, levers, rods, &c.,) but completely alternate and independent of each other. During the operation of pressing, the feeding roller is stationary, and during the raising of the presser the feed roller is in action. I do not intend to claim the principle of compressing the straw at the mouth of the cutting-box at the moment the knives pass through the straw, as I am aware that this has been done in various ways; for instance, by the treadle, by hand rake, and lastly, by levers and cams; but what I do claim as my invention, and desire to secure by letters patent, is—

"First. The combination and arrangement of levers and rods, and

reaching arm, and serpentine grooved wheel, as described, for raising the presser and turning the feed roller simultaneously, and for bringing down the presser at the moment the feed, or reaching arm, slides loosely over the teeth of the rag wheel.

Second. Constructing the feed roller with *curved* teeth, in the manner and for the purpose described, for raking forward the straw without causing it to become entangled upon the teeth, or roller, as described.

"Third. I also claim the combination of the shaft-edged triangular shaped plates, or stops, with the steel plate, at the mouth of the cutting-box, constructed, arranged, and operating in the manner set forth."

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38. For an *Improved Mode of Applying Power to Fire Engines;* Gardner Barton, Jr., and Lysander Button, Waterford, New York, September 19.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the combination, arrangement, and application of the outside lever, as described, and their agreement with the inside levers, in such manner that when force is applied to the hand poles of the inside levers, both powers will agree in forcing the piston of the pump in one and the same direction, while the reverse motion of the levers will prevent the engine from rocking."

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39. For *Improvement in the Double Seaming Machine;* George R. Moore, Philadelphia, Pennsylvania, September 19.

Claim.—"Having thus fully described my invention, what I claim as my invention, and desire to secure by letters patent, is the combination of the roller with the head, constructed and arranged substantially in the manner and for the purpose set forth.

"I further claim the combination and arrangement of the gauge, in the manner and for the purpose described, supporting the inside of the vessel at the bottom while being operated upon, when the sides thereof are flaring.

"And lastly, I claim the employment of the shoulder which terminates the base of the conical part of the head, to keep the bottom in place while making the first bend, as described."

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40. For an *Improvement in the Construction of Head Blocks for Log Carriages for Saw Mills;* Henry Mellish, Walpole, New Hampshire, September 19.

Claim.—"What I claim, and desire to secure, as my invention, by letters patent, is the reversed rows of teeth on the under side of the slide, the jack, and the angular lever, and the dog for moving and setting the slide, the horizontal bar, on which the lever rides, for guiding the jack in the direction parallel to that of the slide, and the movable fulcrum in its block, for gauging the thickness of the stuff to be sawed,

and it is to be expressly understood that I claim them not separately, but in combination, substantially in the manner and for the purpose set forth."

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41. For an *Improvement in the Glass Furnace;* Thomas Leighton, East Cambridge, Massachusetts, assignor to the New England Glass Company, September 19.

Claim.—"Having thus described my invention, that which I claim is my improved mode of arranging the base hole or fuel opening of the fireplace, with respect to the siege and the cave of the furnace, viz.: the placing it below the siege, and in the cave, substantially as above specified."

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42. For an *Improvement in Cooking Stoves;* Jacob Cornelison, Danville, Pennsylvania, September 26.

The patentee says,—"The nature of my improvement consists in the combination and arrangement of the flues, in a stove having two ovens, with the fire between them so as to distribute the heat equally around either or both."

Claim.—"Having thus described my improvement, what I claim as my invention, and desire to secure by letters patent, is the construction and arrangement of the flues, combined in the manner described, with the double oven stove, having a fire chamber between them."

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43. For an *Improvement in the Machine for Rolling Iron;* Benjamin Norton, Boonton, New Jersey, September 26.

The patentee says,—"In rolling the billets of iron that are to be converted into hoop iron, or into scroll, band, or other iron of a like character, the apparatus used, as ordinarily constructed, consists of three rollers, the axes of which are in the same vertical plane. The billet is passed through a groove in the lowermost pair, and is returned through a groove in the uppermost pair, by which it is prepared to be passed through the smooth or finishing rollers. In my improved apparatus I use but two rollers in which the billet is first passed in the usual way; as it passes from between these rollers on the rear side, it enters a curved trough which I call a receiver, and this trough conducts it round the rear side of the upper roller towards the workman in front, who passes it into the groove in the first instance, and who then passes it into a second groove formed in the same rollers;" by which arrangement much time and friction is saved and other obvious advantages obtained.

Claim.—"Having thus fully described the nature of my improvement in the manner of constructing and combining the rollers and other apparatus used in the rolling of hoop-iron, what I claim therein as new, and desire to secure by letters patent, is the combining of the covered trough or receiver with a pair of rollers, for the purpose of conveying the strand to the front of the rollers, in combination with

the employment of the second groove or grooves, in the lower roller, and thereby admitting of the widening out of the collars,—the said combination and arrangement being made substantially in the manner and for the purpose herein fully made known; not intending, however, to limit myself to the exact form of the receiver, as described and expressed, as this may be varied without changing the principle."

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44. For an *Improvement in the Construction of that part of the Hame, commonly called the "Clip" of the common Hame in Hame Harnesses;* Kasson Frazer, Fayetteville, New York, September 26.

The patentee defines the "clip" to be "that part of the common hame which connects the hame tug to the hame wood by a rivet or rivets as the case may be;" and further says his invention "consists in so constructing the 'clip' in a circular form at the forward end as to prevent it from passing inwards upon the collar of the harness and the shoulder of the horse. I call my invention the 'circular self-adjusting clip.'"

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the attaching the curved clips to the front sides of the hames, by means of double joints, so as to render themselves adjustable, and to keep the draught directly in a line from the point of attachment of the clips to the hames, to the point of attachment of the tugs to the whiffletree, in the manner and for the purpose herein set forth."

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45. For an *Improved Apparatus for Drying Grain;* William W. Alcott, Boston, Massachusetts, September 26.

Claim.—"Having thus described my invention, I wish it distinctly understood that I do not intend to confine myself to the precise mode of constructing it as above detailed, but to vary the same in such manner as I may hereafter deem requisite, so long as I do not change its principle, new features, or novelty of action.

"What I claim is a series of two or more hollow cylinders, or other proper shaped vessels, as combined, arranged, connected, and operating together, and with a hot air chamber, or any proper equivalent therefor, substantially in the manner and for the purpose of acting upon grain or other matter, (to be dried by exposure to heat or hot air,) as above specified. I also claim the combination with the cylinders, or other shafts, of suitable mechanism, (such as the wedges and other contrivances as above described, or any proper equivalents,) by which the ends of the said shafts may be elevated or depressed, in order to change the angles of inclination of the said shafts, or either of them, to the horizontal, and thereby cause the grain or other matter to move faster or slower through the cylinder, according to the velocity required during the operations of drying the same."

46. For an *Improved Plan for Locking Drays, Carts, &c., called the "Self-operating Lock;"* Elijah Chapman, Akron, Ohio, September 26.

Claim.—"What I claim to be my invention is the combination of the bars, rods, and springs, and the levers, for the purpose of making pressure on opposite sides of the wheels, whenever the brake is operated."

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47. For an *Improvement in the Construction of Rotary Steam Engines;* James Miller, Philadelphia, Pennsylvania, September 26.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination with the revolving disk, in rotary steam engines, of a valve having the form herein described, or any modification thereof analogous in design and effect, by which the pressure of the steam upon the valve is directed wholly or mainly towards its centre or axis of motion, and upon its axle, and (for the purpose of avoiding friction) only so much on the sliding part as may be desirable or necessary to keep the valve closed on the sliding surface against the revolver.

"I also claim the combination and arrangement of three cams within two valves, constructed as herein set forth, and escapes for the steam at recesses behind the valves, as herein described."

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48. For an *Improved Kiln Drying Apparatus;* Sebre Howard, Adrian, Michigan, September 26.

Claim.—"Having thus fully described the construction and operation of my rotary cylindrical grain dryer, what I claim therein as new, and desire to secure by letters patent, is the uniting the cylindrical casings with each other, and combining them with the furnace in such a manner as to form a circular heating or drying chamber within the inner casing, an annular space or drying chamber connected with the same, between the outer casing and central casing, and an annular flue space between the central casing and inner casing, substantially as herein set forth.

"I also claim the giving the grain or other substance acted upon a constantly progressive rotary movement from the front to the rear end of the circular drying chamber, conducting it into the annular space or drying chamber, and returning the same by a reversed movement to its front end, discharging the kiln dried grain at the spout, by the action of the projecting spiral thread, connecting pipes and spiral thread, combined and operating substantially in the manner and for the purpose herein set forth."

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49. For an *Improved Machine for Carding Wool, Cotton, and other Fibrous Substances;* Charles Bishop, Newtown, Connecticut, September 26.

The patentee says,—"The object of my invention is to make the

action of the card teeth on the fibres continuous, and so to arrange them that a greater portion of the teeth shall be in active service than can be effected by the present method; and this I effect by placing the card teeth on a series of endless belts, which pass around rollers with the surfaces of the belts thus covered with teeth, running in contact along the straight surfaces between the rollers around which they pass, which prevents the card teeth from converging or diverging as when placed on curved surfaces."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method herein described of carding fibrous substances by the action of the straight surface of a belt of cards, stretched and carried around rollers, when this is combined with one or more similar belts of cards, substantially as herein described.

"And I also claim, in combination with such belts of cards, the tables employed for keeping their acting surfaces in the proper line of action, substantially as described."

List of American Patents which issued in the month of May, 1842, *with Exemplifications, by* CHARLES M. KELLER, *late Chief Examiner of Patents in the U. S. Patent Office.*

(Continued from Vol. XIV, page 188.)

40. For an *Improvement in Solar Lamps;* B. H. Horn, Boston, Massachusetts, May 26.

Claim.—"Having thus described my improvements, I shall only claim, as my invention, arranging or forming a trough on the exterior of the fountain, substantially in the manner and for the purpose specified.

"Also, the employment, or arrangement, of an auxiliary, or secondary, lamp, (for the purpose of melting, or liquifying, the concrete substance in the main lamp,) just beneath the fountain of said main lamp, and so that the flame of the former may extend up into the interior tube of the burner of the latter, the construction and operation of the same being substantially as set forth.

"I also claim extinguishing the flame of the auxiliary lamp, and preventing the evaporation of the liquid in the fountain of the same, by means of a sliding lever valve, arranged and operating substantially as described."

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41. For an *Improved Hot Air and Cooking Furnace;* Otis Packard, Roxbury, Massachusetts, May 26.

The claim is omitted, as it could not be understood without the drawings.

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42. For an *Improved Machine for Sawing Boats' Oars from Plank, or Timber;* John Benson and Ezekiel Page, Boston, Massachusetts, and Richard T. Tough, West Leyden, New York, May 26.

The patentees say,—"Heretofore it has been customary to divide

a plank from which oars are to be made into pieces of a width equal to that of the *blade* of the oar, which blade is generally in width double that of the widest part of the rest of the oar. Our method is to separate the plank into strips, in such manner that we obtain nearly double the number of oars from it than by any of the modes heretofore practised."

Claim.—"Having thus fully described our improvements, we shall claim the above described method of dividing a plank into parts, or pieces, from which oars may be manufactured; also, the manner of effecting the lateral movement of the carriage of the sawing machinery, by supporting said carriage on the inclined and declined rails, the whole being substantially as set forth."

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43. For *Improvements in Lamps;* Archibald H. Baird, New York, May 26.

The patentee says,—"The nature of my invention and improvement is in certain new and useful combinations of metallic yoke-shaped conductors with the ordinary burners, for conducting the heat to the parts of the lamp in contact with the lard, or the vessels in which they are placed."

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is making the button a heater, by means of the copper yoke in combination with the inner tube and perforated outer tube in Argand lamps, for burning lard, as described."

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44. For an *Improved Mode of Constructing Bee Hives;* Elijah Grumman, Norwalk, Connecticut, May 26.

Claim.—"What I claim as my invention, and not previously known in the above described hive, is the combination of several boxes of the form above specified, supported as above described, with the ash-box, or trap, above described, for the purposes which are referred to in the specification."

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45. For an *Improved Mode of Making Gloves, Hose, Coats, and other articles of Wearing Apparel, of which Wool, Hair, or Fur is the principal or only Material;* Marmaduke Osborne, May 28.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the making of gloves, coats, hose, or other articles of wearing apparel, of which wool, hair, or fur is the only material, by uniting, by any process of felting, the bats of which any such article is composed, in a flat, or projecting seam, and by cutting away the superfluous parts after such seam is formed by felting, as above described, and without the folding, or turning over, of the edges, or margins, of the bats, which is used in the ordinary process of making bats."

46. For an *Improvement in the Corn Cultivator;* Asa Wood, David Wells & Issachar Bates, of Adams, New York, May 28.

The patentees say,—"The hind teeth are made of cast iron, in the form of an iron plough, with land-side, mould-board, and false point, to be used that they may turn the furrow inwards, (that is, towards each other,) or outwards, (that is, from each other,) by changing the teeth from side to side. The fore tooth is to be also made of cast iron, and differs from the hind tooth in these particulars—that, as the hind teeth each have a land-side, and mould-board, and false point, the fore tooth is made with a *double* mould-board and false point, that cuts and turns the furrow each way."

The claim is to the combination, in one frame, of these teeth, such as are above described.

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47. For *Improvements in Machinery for Ruling Letter Paper;* Geo. L. Wright, Springfield, Massachusetts, May 28.

Claim.—"Having thus described my invention, I shall claim the two cylinders, A, and B,—arranged so that the lowest edge or part of the upper shall be situated at a distance from the upper edge of the lower cylinder equal to, or a little greater than, the length of the sheets to be ruled, said length being taken in the direction in which the sheets move, and said edges of said cylinders being in, or about in, a horizontal plane, and so that the cylinder B shall have a velocity double that of A—in combination with the system of rollers and cords, whereby the sheets are received from an endless feeding apron, upon which they are placed so as to lap over each other, and from thence, are caused to pass around the first cylinder, and be ruled thereon, upon one half of one of their sides, and from thence to pass around the second cylinder, and be ruled over the whole of their opposite sides, as before set forth; the whole being arranged and operating substantially in the manner described."

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48. For an *Improved Grain Cleaner;* Daniel Flickinger and Sebastian Krim, Hanover, Pennsylvania, May 28.

Claim.—"What we claim as our invention, and which we desire to secure by letters patent, is separating garlic from wheat, by passing the grain and garlic between rollers covered with India rubber, or other elastic substance, that will mash the garlic and, at the same time, not injure the wheat, but increase the size of the garlic, and prevent it from passing through the meshes of the inclined screen through which the grain passes, in the manner described, or in any other mode substantially the same; and in combination therewith, the arrangement of the several inclined screens, conducting-boards, spouts, and tubes, as set forth."

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49. For *Improvements in Cultivators;* John Mason, Haddonfield, New Jersey, May 28.

This patent is granted for the addition of bands, as they are termed, hinged to the beam, between the handles, for lifting vines.

50. For an *Improvement in Brushes, for Dressing Warps;* Samuel Taylor, Lowell, Massachusetts, May 28.

The patentee says,—"My invention consists in arranging the bristles between strips of wood, or in parallel grooves formed in the block, or by laying the said strips side by side, and interposing between their extremities, at each end of the brush, small pieces, whose sides are covered with glue, to cause their surfaces in contact with the strips to adhere thereto. The upper parts of each side of the strips, in opposition, are chamfered, or beveled off, so as to form an inverted trapezoidal groove, in which, and among the tops of the bristles, pitch, or cement is poured, by which the bristles are further secured in their respective positions. Each line, or layer, of bristles, when placed between the strips, should be saturated with a mixture of white lead, or other suitable paint, and linseed, or other proper oil, which causes the bristles to cohere, and prevents their displacement by the action of water, or the sizing material used in dressing the warp."

Claim.—"Having thus fully described my invention, I shall claim securing the bristles in position and preventing their displacement by the action of water, or other external cause, by saturating said bristles, when inserted in the block, with paint, or a mixture of white lead, or other suitable substance, and linseed, or other proper oil, *in combination* with the mode, above set forth, of confining their upper ends by cementing them in an inverted trapezoidal groove, the whole process being substantially as above described, so that when a brush for dressing warps has its bristles arranged and confined, as set forth, in long grooves, or in any manner similar thereto, said brush will apply paste, or sizing matter, more perfectly upon the threads of the warp, and be more durable than brushes as generally constructed, as heretofore explained."

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51. For an *Improved Stave-dressing Machine;* Samuel Leamed, Ridgeway, New York, May 30; antedated November 30, 1841.

Claim.—"I am aware that machines have been made for dressing staves by forcing them through between knives, by a follower, operated by a rack and pinion, and I do not, therefore, claim this as of my invention; but what I do claim as my invention, and desire to secure by letters patent, is the arrangement for throwing the rack out of gear, by having the receiving box, in which the slide works, hung at one end by a joint, or roll, and the other provided with a stirrup, or staple, in combination with the spring catch on the frame, and the cam-piece, or guard, on the slide in the manner described; and, in combination with the above, I also claim the foot and cross levers, for the purpose of throwing the rack into gear, as described."

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52. For *Improvements on his Loom for Weaving Counterpanes, and other Articles;* Erastus B. Bigelow, Lancaster, Massachusetts, May 30; antedated May 1, 1842.

Claim.—"What I claim therefore, as constituting my inventions,

and which I desire to secure by letters patent, is the within described manners, or modes, of mounting the loom, and tying up the harness, and of working the same, in which, under its various modifications, I combine a movable harness board, or boards, with one or more leaves of heddles or harness, and with the Jacquard machine in the power loom; such arrangement and combination being substantially the same with that herein described."

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53. For a *Machine for Manufacturing from Wood, such as Cedar, Basswood, Poplar, and other straight-grained Wood, a Commodity to be used as a Substitute for Curled Hair, in Stuffing Cushions, &c.;* William Baker, Utica, New York, May 30; antedated November 30, 1841.

The patentee says,—"The nature of my invention consists in the construction of a machine by which the wood is cut, lengthwise of the grain, into fine threads, or fibres, which are so curled, and crimped, by the same process, that, when in the mass, they constitute a light and elastic article, suitable to the purposes aforesaid."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the fluted cutters with the smooth cutter, for the purposes of producing the article herein described, and their arrangement in the plane stock, as above set forth; together with their adaptation to the uses of the machine, of the apparatus, above described, for holding the timber, and feeding out the same to the plane, as the surface is cut away. The whole being combined and connected with the machine, as herein set forth."

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54. For an *Improved Tent;* James H. Dakin, New Orleans, Louisiana, May 30.

The patentee says,—"The nature of my invention consists in the formation and combination of a light frame-work with a small upright shaft, and arms attached to it by means of hinges and cords, rendering the arms movable from a horizontal to a perpendicular position, and the application of such frame-work to any tent where the covering of the tent is made of cloth, or any flexible, or pliable, material, and formed with any number of sides. A tent so formed, may be suspended from above, or supported from below, as the case may be, and folded up, and expanded, in effect somewhat similar to the folding up and expansion of a common umbrella."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the application of a light movable frame-work to tents, fixed permanently in the roof, or upper part, of the tent, which will allow the tent to be folded up and closed, or unfolded and formed for occupation and use, at pleasure, as herein described, using, for that purpose, wood, metal, or any other material that will be suitable to accomplish the intended operation and effect."

55. For a *Machine for Grinding and Polishing Saw Plates, &c.;* Richard M. Hoe, New York, May 30.

Claim.—"What I claim as new, and desire to secure by letters patent, is the combining with the reciprocating beds, or tables, or with the revolving disk, or face-plate, the cylindrical lap, herein described, which is made to traverse back and forth upon its axis, and which may be borne up, with any required degree of force, against the article to be ground, or polished, in the manner set forth; the face, or periphery, of said cylindrical lap being composed of a number of separate and distinct plates of metal, which are to constitute the grinding and polishing surfaces, and which are to be held in place by a screw, and by being confined between rims, or in other suitable modes, substantially the same; the distinguishing feature of the said lap being the dividing of its periphery into separate plates, and combining the same together, as herein set forth."

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56. For an *Improved Press, for Pressing Hay, Cotton, &c.;* Caleb Martine, Greensburg, New York, May 30.

The patentee says,—"This improvement is principally in combining the gearing and piston with a turning post, so that the piston can be raised from the box, and turned aside from it, for the purpose of filling the box."

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is the mode of turning aside the piston from the box, to fill the same, and returning the piston and gearing to the box, in order to press the hay, by means of the combination of the turning post and beam with the gearing and cogged piston rod."

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57. For an *Improved Lamp for Burning Pine Oil;* Michael Boyd Dyott, Philadelphia, Pennsylvania, May 30.

Claim.—"First, I claim the air regulator, substantially as above described. Second, The combination of the two horizontal plates, the one above, and the other below, or even with, the top of the wick, to regulate the interior draught of the lamp, substantially as above set forth. Third, I claim the mode of regulating the light, by raising or lowering the burner and outside regulating cone combined, the centre plate being, at the time, stationary, substantially as above described. Fourth, I claim the mode of constructing a wick tube, its upper end being conical, or enlarged, so as to admit of a feeder being placed under the wick without enlarging it in diameter, substantially as above set forth."

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58. For *Improvements in Stoves for Culinary and other purposes;* Benjamin Shepard, Boston, Massachusetts, May 30.

Claim.—"Having thus explained my invention, I shall claim surrounding the fire or flue space which encircles the oven, and through which the smoke and heated products of combustion pass from the

fireplace to the chimney, by an exterior casing, so as to form another space around said oven, into which atmospheric air may be introduced, and be warmed by contact with the casing, and from thence be conveyed to one or more apartments by pipes suitably arranged, *in combination* with a hot air chamber arranged in rear of the fireplace, and below the smoke passage, and open at bottom, for the free admission of air therein; said two hot air spaces, or chambers, being connected together by one or more suitable pipes, and otherwise arranged substantially as hereinbefore set forth."

MECHANICS, PHYSICS, AND CHEMISTRY.

On Reaction Water Wheels.

TO THE COMMITTEE ON PUBLICATIONS OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

On the subject of Barker's wheel, which, with a few exceptions, appears to be the only reaction wheel noticed in the elementary books till recently, I have seen no notice of any variation in the discharge, caused by variations in the velocity of the wheel; from which I infer that the writers regarded them as uniform in their discharge under all velocities.

In practice, however, it has been observed that, when the wheel runs without resistance to its free motion, the orifice moves with a velocity considerably greater than that due to a pressure of the head of water, and that the discharge is greater than the theoretic discharge.

So far as I am informed, no experiments have been recorded, or rules given for determining the ratio of discharge under different velocities of such wheels.

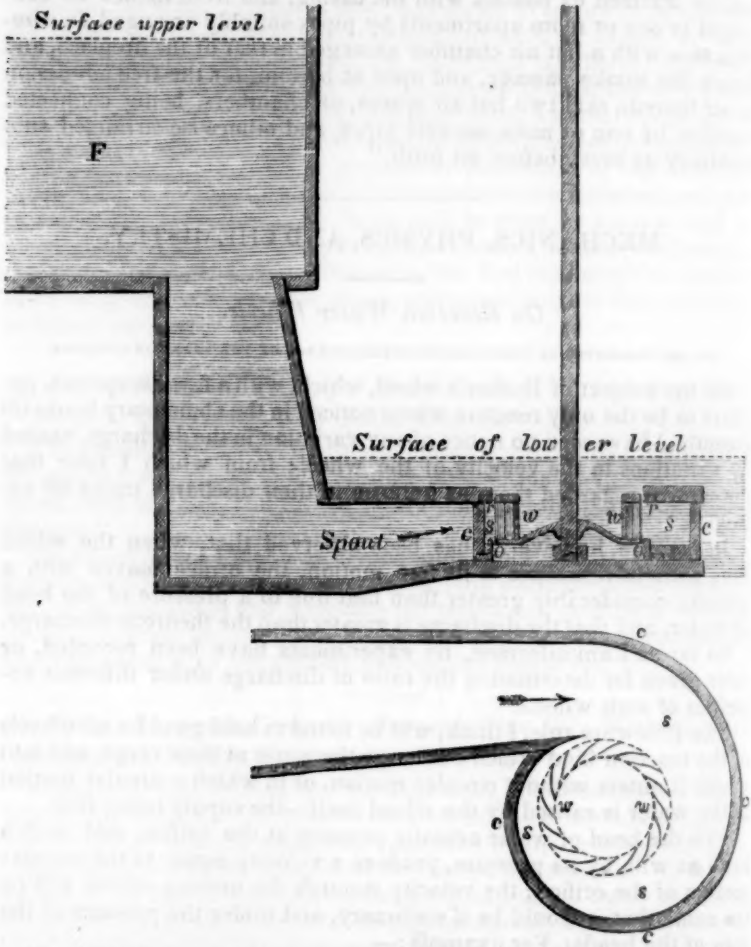
The following rule, I think, will be found to hold good for all wheels of the reaction kind which discharge the water at their verge, and into which it enters without circular motion, or in which a circular motion of the water is caused by the wheel itself—the supply being full:

"To the head of water actually pressing at the orifice, add such a head as will, by its pressure, produce a velocity equal to the circular motion of the orifice; the velocity through the moving orifice will be the same that it would be if stationary, and under the pressure of the sum of the heads: For example:—

Suppose such a wheel to have an issue of 36 square inches, under a head of nine feet, and that the orifice move at the rate of 16 feet per second; the discharge will be the same that it would be if the wheel were standing under a head of 13 feet. Consequently such a wheel would, by this theory, discharge, standing, 6 cubic feet per second, and running at that rate, 7·2 cubic feet. And, if the orifices were suffered to move at the rate of 24 feet per second, the discharge would be the same as if standing under 18 feet head; in which case, the discharge should be 8·48 cubic feet per second.

It is obvious that, in applying this rule in practice, such deductions

must be made (as in other cases) as may be due to the form of the orifice, the angles in the passages, and the friction on surfaces.



The following experiments were made with a centre discharge reaction wheel of the form and proportions represented in the accompanying sketch. The wheel was 34 inches in diameter at its outer verge; the inner diameter of the annular rim 26 inches. It had 16 issues, (8 by 1·8 in.) = 230 square inches. It received the water at the verge, from an involute sluice embracing the whole circumference. The water was conducted to the involute through a large spout; the discharge of which into the involute, 24 in. wide by 14 in. deep, = 336 square inches. The terminus of the involute was within an inch of the verge of the wheel. The circular motion of the water caused by the involute coincided with the motion of the wheel.

Power Expended.					Effect Produced.				
No. of Experim'ts.	Fall of water in feet, $= h$.	Cubic feet of Water used per minute, $= d$.	Pounds of Water per minute, $d \times 62{\cdot}5 = w$.	Whole power of water, in lbs. descending 1 ft. per min. $h \times w = p$.	Weight on lever of brake $= w'$.	Revolutions per minute $= v$.	Effective force of wheel, $w' \times v \times 60 = f$.	Ratio or practical co-efficient $= R$.	Remarks.
1	8·66	1125·5	70,312·5	608,996	30	143	255,600	·411	Good.
2	8·62	1119·0	69,937·5	602,861	39	138	312,920	·518	do.
3	8·61	1119·0	69,937·5	602,861	45	130	351,000	·582	do.
4	8·59	1104·0	69,000·0	592,711	66	87	344,520	·579	do.

The condition of the works at the time the experiments were made was favorable to the wheel. It had run about two months after being repaired and adjusted, and the proprietor, (Mr. A. Atwood, of Troy, N. Y.,) stated that it was performing as well as it ever had. There was a fault, however, in the construction. The "spout" (so called) conducting the water from the flume had an elbow of nearly a right angle, first descending from the bottom of the flume and then passing horizontally to the involute; the section at the commencement of the horizontal portion being about 16 by 36 = 576 square inches. The opening into the "spout" from the bottom of the flume was about 30 inches square, with sharp angles. All things considered, I am of the opinion that this method of employing the "pressure" of water, with a good structure, in good condition, is capable of giving about 62 per cent. of available power.

A remarkable feature of inward-discharging reaction wheels is found in the smallness of their discharge, and its tendency to uniformity under all velocities of the wheel, obviously arising, in this application, from the outward pressure of the circular motion of the water in the involute sluice and wheel.

The theoretic discharge of 230 square inches, under a pressure of 8·61 feet, is 2249 cubic feet per minute. The actual discharge is only ·498 of this. Had the discharge been outward, through the same aggregate aperture, and with the same circular motion of water, in the portion of the wheel occupied by the vanes, the discharge, (judging from the results of my experiments made in 1844,) would have been ·884 of theoretic discharge; and had it been outward, and *without* circular motion, it would have been about 1·289, at the speed of maximum power.

Z. PARKER.

Philadelphia, November, 1847.

The Chinese Magic Mirror.

TO THE COMMITTEE ON PUBLICATIONS OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

I notice, in your last number, an attempt to solve the mysterious phenomenon of the Chinese magic mirror: as that explanation seems to me erroneous, I am induced to offer another solution, which, if I am correct, can easily be verified by some of your ingenious readers. My attention was called to this curious piece of Chinese ingenuity by the intelligent proprietor of the Chinese Museum, in Boston, some time since. I examined it with attention, and found that the mirror consisted of a thin, flat plate of copper, with Chinese characters and figures on the back, projecting nearly the eighth of an inch from its surface; the face of the plate was silvered, and highly polished, and, on the closest inspection, no difference appeared on any part of the surface; the plate seemed to be of one casting, and the silver plating put on in the ordinary way, and equally polished. If this mirror was placed in the sun-light, so as to cast its reflexion on the wall, the characters that were raised on the back of the plate appeared in a brighter reflexion than the other parts of the mirror, which would seem to prove that those parts could not be made of a coarser metal. I therefore came to the conclusion that, in consequence of those parts over the characters being rigid, and the other parts elastic, a slight inequality of polish was produced on the different parts of the surface; so small, indeed, as not to be detected in any way but by testing its powers of reflexion.

J. J. GREENOUGH.

Washington City, D. C., Nov. 30, 1847.

On the Theory of Dew.

We find, in the "*Annales de Chimie et de Physique*," for October, 1847, two letters from M. Melloni to M. Arago, containing an account of some interesting experiments made by the former upon the production of dew, and the opinions and conclusions resulting from his researches relative to the subject. Not being able to afford space for the whole, we translate such portions as appear to us sufficient to explain the views of the author.

After the experiments of Wells, he thinks it might have been surely admitted, that dew neither rises from the earth nor falls from the sky, but is formed from an invisible and elastic fluid diffused throughout the space which surrounds bodies, and that the precipitation of this aqueous vapor should be attributed to the cold resulting from the calorific radiation of bodies towards the clear sky. According to this view, the leaves of vegetables, wood, glass, varnish, lampblack, &c., will be covered with dew, because they easily part with their heat and are considerably cooled when exposed to the sky: while the metals will remain dry, on account of their feeble power of radiation towards the upper regions of the atmosphere. If a polished metallic

vessel, filled with boiling water, be presented to a thermoscopic apparatus—and afterwards one exactly similar, with its sides covered with varnish, or lampblack—the radiation of heat indicated in the latter case will be much greater than in the former. But however clear may be the deduction, it would seem that it has not been so considered by all. Indeed, Benedict Prevost, and Saussure before him, attributed the absence of dew upon metals to an electric influence; Leslie explained this phenomenon by a particular repulsion exercised by metallic surfaces upon aqueous vapor; and the supporters of the theory founded upon the supposed rising of dew, account for it by the heat and electricity disengaged in the chemical action of metals upon the molecules of this same vapor, at the moment of their passage into a liquid state.

In order to show that these different hypotheses could not be sustained, M. Melloni took three thermometers, graduated upon the stem, and passed each through a cork, which remained fixed at a distance of about a quarter of an inch from the bulb. This cork served as a support to the two parts of the metallic casing with which the thermometers were enveloped; the first being a little vessel of silver, or copper, very thin, similar to a thimble, with its surface smoothed and polished, of sufficient size to contain the bulb of the instrument; the other, a cylinder of tin, closed at one end and open at the other, used to cover the graduated tube of the thermometer. These two metallic pieces, which could be very easily removed and replaced, were readily kept in their proper positions by the friction and elasticity of the cork. Three tin vessels were then prepared, supported by slender metallic tubes, and having lids, or covers, of the same material; an opening being made in the side of each, near the bottom, into which were introduced the covered bulbs of the three thermometers, leaving the tubes and their envelopes horizontally disposed on the outside. The casing of one of the thermometers was blackened, and the others left in their bright state, with a view of comparing the nocturnal radiation of silver with that of lampblack. The whole was exposed to the free air in a calm and still night, the tin vessels being sometimes open and sometimes closed by their covers. When closed, the three thermometers indicated the same temperature; but on leaving one of the vessels containing one of the bright-cased thermometers closed, and opening the two others, the falling of the mercury in the bright-cased thermometer, thus opened to the sky, was so slow that it required a very delicate instrument and very exact comparisons to observe and measure its movement; while the blackened thermometer fell so rapidly as to be readily seen, and in a few minutes it marked three or four degrees less than the one in the closed vessel—thus proving, evidently, that this difference was due to the radiation, towards the sky, of caloric from the blackened instrument, and by no means to the contact of the exterior air, which acted equally upon it and upon the polished case of the other uncovered thermometer.

Thermoscopic apparatus, similar to those just described, having the cases covered with varnish, plumbago, fish glue, saw dust, sand, earth, and the leaves of plants, have constantly indicated a very sensible di-

minution of the temperature before being covered by dew. The interval has been sometimes for several hours; and there is often, also, an abatement of the temperature without the precipitation of vapor at any period of the night. The latter phenomenon occurs the more frequently as the thermometers are placed at a greater distance from the ground. Operating at a certain elevation, the deposit of dew upon bodies might, therefore, be suppressed, or retarded, and the fact be incontestably established that the formation of dew always follows, *and never precedes*, the production of cold. M. Melloni remarks that he has never seen the polished metallic cases of his thermometers covered by a condensation of aqueous vapor, in very damp nights, when there was no appearance of fog, or mist, in the atmosphere.

From all this, he concludes that dew, properly so called, always requires a certain cooling of the bodies upon which it is found; and that metals, exposed to a clear sky, are not covered with dew, because of their possessing the quality of being thus cooled but in a very slight degree. In order to determine whether other causes existed to prevent the accumulation of dew upon metals, and whether their feeble radiation is really the only and true cause of their being never covered with dew, he undertook the following experiment, the result of which he considers conclusive, and that it proves, at the same time, the falsity of the hypotheses of the rising and the falling of dew, as well as the truth of the principle asserted by Wells.

Upon a disk composed of a single plate of tin, as large and as thin as could be obtained, he drew a concentric circle with a radius equal to one-third of that of the disk, and covered it with a thick coat of varnish. From another plate of tin, he then cut a second disk, with a diameter about half an inch less than that of the varnished circle, and soldered to its centre, perpendicularly to the surface, the end of a piece of iron wire, ·08 of an inch in thickness, and eight or ten inches in length, pointed at the other end, which was inserted into a small hole made in the centre of the larger disk. Being inserted on the varnished side of the larger disk, the wire was pushed through until the distance between the two disks was reduced to about two-tenths of an inch, and then fastened in that position by a few drops of solder. The two plates, thus united, being taken, in a calm and clear evening, into an open field, and left in a horizontal position for a short time, removed from contact with other bodies, showed on the surface of the larger disk, phenomena of dew which may be readily anticipated.

The smaller disk being uppermost, and its radius being a quarter of an inch less than that of the varnished circle upon the larger disk below, it follows that an annular band of that circle, a quarter of an inch in breadth, extended around the vertical projection of the roof formed above it by the little metallic disk. Now it is apparent that this band would radiate towards the sky, lose a portion of its temperature, become covered with dew, and communicate, little by little, both cold and dew, consecutively, towards the centre and also towards the circumference. In the latter case, however, this propagation would be carried much further than in the former; for the portion cooled by communication would be further cooled by radiation when covered

with dew—while the varnished portion, under the smaller disk, would be scarcely cooled except by contact. In effect, the central part of the varnished circle remained always dry, and the metallic zone which surrounded it became wet, even to the extremity, if the atmosphere was very moist.

But what could not, perhaps, have been anticipated at first, was the exact reproduction of the same appearances upon that side of the larger disk which was towards the ground. The dew began to show itself upon this side at points opposite to the little exterior ring of varnish, and a slight whitish circle was perceived, which, appearing all at once upon the blank field of polished metal, seemed like the formation of a Daguerrian image. This circle, becoming stronger and spreading by degrees, sometimes extended to the edge of the plate, but never reached the central part, which always remained dry and maintained its metallic brilliancy, like the corresponding portion on the other side of the disk, and the little circular roof, which covered without touching it.

This simple and easy experiment may be regarded as furnishing conclusive evidence upon several points connected with the theory of dew. It shows that dew does not fall from the sky—for the upper disk always remained dry, while the greater part of the lower one is moist. Neither does dew rise from the ground—for if a portion of the under side of the lower plate is covered with dew, there is always a space around the centre which remains dry and shining. The theory that metals repel the aqueous vapor which forms dew, or that they cause its evaporation as rapidly as it may be precipitated upon them, is disproved by the fact that we here see some parts of the metallic surfaces quite wet, while other parts remain perfectly dry.

The first appearance of dew upon the uncovered band of varnish, and its successive propagation to adjacent and opposite portions of the larger disk, associated with the increase of temperatnre developed by the varnished cases of thermometers exposed to the open air, prove, in short, that dew is a mere consequent of nocturnal radiation, which produces, in bodies endued with great emissive power, the degree of cold necessary for the condensation of the elastic aqueous vapor diffused in the atmosphere.

In his second letter, M. Melloni proceeds to show that, if the principle of Wells concerning the origin of dew were established beyond doubt, it would still be impossible to account for all the thermometric and hygrometric phenomena which are produced during a clear and still night, without taking into consideration a new circumstance, until now entirely neglected, notwithstanding its exceeding importance in the nocturnal cooling of bodies. But before proceeding to give an account of this, M. Melloni makes some observations upon two series of experiments which the supporters of the theory that dew rises from the earth have put forward with the pretension that these alone are sufficient to overturn all theories of dew founded upon the principle of calorific radiation.

They took a certain number of thermometers, as nearly equal as possible in volume and in sensibility; some of which were coated with

lampblack, varnish, Indian ink; others gilded, silvered, covered with leaves of plants, tin, copper, &c. These instruments, thus prepared, being exposed in the fields during a clear and still night, at first indicated temperatures with some little difference; but after a certain space of time they were found to agree very nearly. The experiment was then varied in the following manner. Cylinders of glass were planted in the ground, on the tops of which were placed plates of zinc, copper, and glass, in each of which was made an opening to receive the bulb of a thermometer, whose tube, supported by an iron wire, was elevated above the upper surface. A thermometer was freely suspended between the plates, for the purpose of showing the temperature of the air. In this case, as in the other, the apparatus being exposed early at night, indicated differences of temperature which afterwards disappeared, insomuch that by daybreak next morning all the thermometers were found at nearly an equal height.

The opponents of the principle established by Wells, regarded these results as decisive, and they consequently stigmatized the principle that the nocturnal cold of bodies is indispensable in the formation of dew, as a mere chimerical illusion. M. Melloni, on the contrary, thinks that if there is anything imaginary, or fantastic, in the matter, it is in the reasoning which led to such a conclusion; inasmuch as the experiments of these gentlemen were made near the ground, in an atmosphere charged with moisture—all the tubes of the thermometers being uncovered—and in the last experiment the bulbs communicated, by means of the plates, with the cylinders which served to support the apparatus. Now the glass of which these tubes and cylinders were composed radiated considerably, its temperature was reduced, and the cold acquired was communicated to the bodies which touched it; these, being surrounded by a very moist atmosphere, then condensed the aqueous vapor; and we know that water radiates and cools itself with as much energy as glass, varnish, and lampblack. It is not, therefore, surprising that the thermometers in contact with the sheets, or plates, of metal, should indicate, after some time, the same temperature as the thermometers surrounded by substances which radiate most; and because the metallic surfaces, *which were found to be covered with dew*, were as cold as the glassy, or the blackened, surfaces, it might well follow that water, glass, and lampblack, are substances of nearly equal emissive power. But without a resort to poetic fiction, it would never be logically inferred, from this experiment, that metals are cooled, during calm and clear nights, as much as lampblack and glass.

In order, therefore, to understand the true condition of things, glass should not be used for the supports, but slender tubes of tin, which have scarcely any radiation, and maintain the thermometers sufficiently isolated from the warmth of the ground; it is necessary, moreover, to enclose every part of the thermometer with metallic laminæ. Then, these laminæ being polished, the thermometer will give a temperature very nearly approximate to that of the air, and when the metallic enclosure is varnished, blackened, or in contact with vegetable leaves, or any other substance, we can ascertain, by a simple com-

parison with the bright thermometer, the degree of cold produced by the radiation of this substance. By means of instruments thus prepared, M. Melloni has assured himself that the leaves of plants, glass, varnish, and lampblack, are always cooled in clear and still nights, from one to two degrees (Centigrade*) below the temperature of the surrounding air.

In observing the small amount of this cooling, it might seem that the decrease of temperature of seven or eight degrees, reported by Wilson and Wells, was a great exaggeration. But considering that the differences obtained by these gentlemen contained an element foreign to the question, that the thermometers used to obtain the ambient temperature were elevated four or five feet, while the instruments enclosed by the radiating substance were very near the ground, it is easy to understand the reason why there is so great a difference between the results obtained by them and those of the writer.

M. Melloni then refers to the experiments of Peclet, which showed, long ago, that the temperature of the air, in calm and clear nights, decreases rapidly as we approach the surface of the earth. He observes that the simple fact of this decrease ought to render the temperature of a radiating substance, placed near the ground, inferior to that of the air surrounding a thermometer elevated four or five feet; so that, in this arrangement, the difference of the two instruments by no means shows the desired result, namely, the cooling of the body below the temperature of the ambient medium.

There is, however, one experiment of Wells, in which a thermometer, wrapped in wool, being placed on the same level with a free thermometer, showed a decrease of temperature amounting to 5·3 degrees. Here, the wool was cooled to a degree two or three times greater than the lampblack used in the experiments of M. Melloni, who remarks that he knows, notwithstanding, that the emissive power of wool is not greater than that of lampblack. In order to investigate the cause of this extraordinary discrepancy, M. Melloni enveloped the coating of one of his thermometers with wool, and exposed it to the air with two others of the same size, one of which was covered with lampblack, and the other retaining its metallic brightness. In a few minutes the descent in the instrument wrapped in wool was twice as great as that in the blackened thermometer. A fourth instrument was then enveloped in an equal quantity of wool, which was closely pressed and confined around the metallic casing by means of a thread of the same material: this showed a cooling intermediate between the two former indications. He next enveloped a fifth thermometer with a double coat of fine flannel, which fell still less than the fourth. The experiments were repeated by substituting cotton for wool, and results altogether analogous were obtained. I then comprehended, says M. Melloni, that the superiority of cotton and wool over lampblack, in the phenomena of nocturnal cooling, was due to a certain modification effected in the emissive power of these bodies by the presence of the air contained within their interstices.

* A degree of the Centigrade thermometer, which is used by the French philosophers, is equal to one and four-fifths degree of Fahrenheit.

The agency of air in thus augmenting the cold produced by radiation, he explains as follows: It has been known, for a number of years, that the nocturnal cooling of bodies does not vary with the temperature of the atmosphere. Thus, Captains Parry and Scoresby found that, during calm and clear nights, in the polar regions, the snow cooled about nine degrees below the stratum of air at four or five feet high, when the atmosphere was at 25 or 30 degrees below 0, and the same when the temperature was very near 0. M. Pouillet has seen the down of the swan fall about seven degrees in temperature at 0, and at 2·5°. And, on his own part, M. Melloni assures us that the fall in his blackened, or varnished, thermometers is a constant quantity, whatever may be the temperature of the night. Now it may be conceived that the tufts of cotton, or wool, spread over the upper part of the thermometric bulbs under the action of a clear sky, after being cooled by radiation, would communicate the cold thus acquired to the surrounding air, which, becoming heavier, descends within, and falls towards, the ground; but there is always required, by this condensed air, a certain time for its disengagement from the obstacles which arrest it among the threads. These are, then, surrounded by an air colder than it was at the commencement of the experiment; and as *their decrease of temperature below the ambient medium must continue invariable*, it necessarily follows that they must cool still further. This increase of cold will produce a further decrease of temperature in the medium; the fall of temperature in the medium will react by still further cooling the radiating body, and so on, continually, until the weight acquired by the condensed air delivers it from the obstacles which opposed its passage from the enveloping substance.

This process, which takes place when tufts of cotton, or wool, are artificially placed around thermometers, must occur naturally under many circumstances. Thus plants which have downy leaves are colder than those whose leaves are smooth and glossy. The temperature of grass, and other low plants, which cover the fields, falls, by reason of this frigorific reaction of the air, considerably below those of more elevated growth, on account of the immediate proximity of the earth, which sustains the ambient medium and compels it to remain about the radiating surfaces. In fact, the stratum of air which envelopes the grass of a meadow is not maintained at rest; but, on the contrary, is subjected to agitation similar to that of water in a vessel placed over the fire: the particles condensed by the cold of the pointed leaves of grass descend to the ground, are warmed by contact with the earth, ascend again among the herbage, and so on, continually. But it is evident that, notwithstanding this state of agitation, the temperature must be finally decreased; and that the grass, to be kept continually cooler than the air by a constant ratio, must itself become cooler and cooler, which will produce a gradual reduction of temperature and an increasing humidity in the stratum of air.

M. Melloni concludes his second letter by announcing that he will shortly submit to the Academy a memoir, in which he will treat of a number of interesting and important questions connected with the nocturnal reduction of temperature, and the production of dew.

In the "*Comptes Rendus*," for October 11, 1847, is a third letter from Melloni to Arago, complaining that certain journals had misrepresented his views as expressed in the former letters, and making further remarks upon the subject under discussion. This letter we translate as follows:—

My studies upon dew seem to me to have placed beyond doubt this fact, that if the principle of Wells is true, the theory which goes by that name is erroneous, or, at least, altogether incomplete. I thought I had so clearly defined this proposition that no mistake could arise; but in looking over several periodical publications, I find that it has been altogether distorted. In effect, the conductors of these journals adopting, perhaps, the opinion of him among them who first gave an account of it, cite the first part of my theorem and say nothing of the second; the reader is thus led to believe that my labors tend solely to confirm the theory of Wells, such as it is developed in all the physical and meteorological treatises; though my experiments lead to a directly opposite conclusion. I shall endeavor to make myself better understood, starting from the data themselves which form the basis of this theory.

Let us suppose two pairs of thermometers, enclosed in their metallic cases, and suspended by means of thread, or metallic supporters, according to the method described in my first letter. Suppose each of these pairs to be composed of one thermometer with a bright case, and another blackened. And suppose, finally, that, during a still and clear night, one of these pairs should be fixed very near the grass in an open meadow, and the other at four or five feet high, so that the two thermometers of each pair shall be at the same level.

After being exposed thus for a few moments, the blackened thermometers will be seen to descend about 1·5° (Centigrade) below the metallic thermometers placed by the side of them. The temperatures, however, indicated by the lower couple will be very different from the temperatures marked by the higher two; this difference will reach to five or six degrees in calm and clear weather; and as the lowest indications will always be shown by the pair lowest in position, we infer from this that the differences observed between the indications of the two pairs of instruments, proceed solely from the unequal temperatures of the different atmospheric strata in which they are placed, and that consequently, during calm and serene nights, the temperature of the air decreases rapidly as we approach the surface of the ground.

Now the experiment upon which the theory of Wells is founded, consists in the often repeated observation that a common thermometer, placed in contact with the grass, indicates a considerably lower temperature than one elevated four or five feet from the ground; from which it has been concluded that the grass was cooled several degrees, by radiating towards the sky. But it is easy to satisfy one's self that this deduction is by no means correct. Place the glass bulb of one of your thermometers in contact with the grass, and hold the other freely suspended in the air, at the same distance from the ground, and you will find that the two instruments mark the same degree. Now no one will deny that this is not the way we should operate, to demon-

strate, according to the old method, the reduced temperature of the grass below that of the surrounding medium. We are, therefore, compelled to admit that the fundamental data of the theory of Wells are inconclusive:—1st, Because the surfaces of the thermometers used have as much radiation as the leaves of the grass. 2nd, Because the thermometer intended to measure the temperature of the air was placed in an atmospheric stratum much warmer than that which surrounded the vegetable leaves placed in contact with the other thermometer.

The principle of the formation of dew, in consequence of the cold produced by the radiation of bodies is, I repeat, entirely just, and the theory of Wells inaccurate. The cause of this inaccuracy is evidently in consequence of having entirely neglected to consider the influence of the air in the production of the cold which is successively developed near the surface of the earth. It has, indeed, been said, vaguely enough, that radiating bodies, situated at a certain height, will not have their temperature lowered as much as those placed near the ground, on account of the descending currents which are formed around the former, and cannot exist around the latter. But that is insufficient to show the real agency which the air has in the formation of dew.

It was necessary to demonstrate, as I believe myself to be the first who has done, that, notwithstanding its incapacity of cooling by radiation, the air which rests very near the earth contributes greatly to lower the temperature of plants surrounded by it, by means of a series of actions and reactions, of which the cause and the effects are clearly defined, if I mistake not, in the second of the two letters which form the subject of this discussion. You, who have perfectly comprehended their true meaning, will doubtless permit me to spare you the fatigue of a useless repetition, and to recommend to the conductors of the journals just mentioned, a somewhat more attentive perusal of the numbers of the *Comptes Rendus*, in which they were inserted. After which they shall have full and entire liberty to prove that I am wrong; but they will first admit, at least I hope so, that they have wrongly informed their readers with regard to the consequences resulting from my investigations of the phenomenon of dew.

New Mode of Making Artificial Magnets.

Sir,—As magnetism is now applied to many purposes of practical utility, as well as in many instructive and amusing experiments, and as artificial magnets can easily be made of greater power than loadstones, I presume it will be acceptable to many of your readers to know how artificial magnets may be made without any risk of failure.

Makers of magnets and compass needles know that if the most careful and skilful workman be employed in preparing a number of magnets from the same steel bar, the magnetic power of the magnets, when compared with each other, will greatly vary; although every possible care may be taken in forging, tempering, and magnetising, in

a uniform way. Experience in these matters convinced me that discrepancies in the magnetic powers of magnets of the same length, weight, and quality of steel, arise from the *tempering alone;* for if the metal be heated in a furnace, or coal fire, one par tof the bar may be in contact with glowing coal, another part in flame, a third in heated air, a fourth in contact with coal in a state of ignition, &c.; consequently, the metal is not in all its parts raised to the *same* temperature, when suddenly removed from the fire and plunged into a cooling fluid. The relation between the degrees of heat in the heating and cooling mediums is absolutely unknown; magnets tempered in this uncertain way will possess different degrees of hardness throughout their length, and their capacity for magnetism in all their particles will be unequal and uncertain.

Reasoning in this way, it appeared to me, that in order to make compass-needles and steel magnets successfully, we require *specific heats* in the *warming* as well as in the *cooling* process of tempering; in order to insure the same degree of hardness throughout the steel bars; that is to say, that the metal when cold should be a homogeneous mass, and possess a uniform capacity for the reception and retention of the magnetic virtue.

Metalurgists know that lead melts at a low temperature, but if left on a good fire, it gets first a red, and then a white heat; that continuing to absorb caloric, it ultimately *boils* at a uniform heat, which melts gold or silver, as is evident in the process of "cupelation." Now here we have a *specific* heat at probably 5000°, and we have also a specific heat of boiling water at 212°. It therefore struck me that by heating my needles in boiling lead, and cooling them in boiling water, every particle of the steel would be first raised to, and then cooled down to the same temperature and degree of hardness. The experiments have been made with complete success; and more powerful magnets have been made in this way than were ever made before, *without risk of failure.*

Magnets weighing 600 grains, and 6 inches in length, have held in suspension 14 times their own weight; and compass-needles have given by deflection 30°, at twice their length, from a test-needle. I find that magnets tempered in this way are not liable to break, but possess with great hardness a *toughness*, derived probably from the boiling water. Their power of retaining the magnetic energy has *for four years* remained unimpaired, although left without "keepers."

To manufacturers of magnets and makers of compass-needles, a knowledge of this mode of tempering steel, at a specific temperature of the heating and cooling mediums, will enable them to make articles of a superior quality without risk of failure, or needless expense; and as I have no other object in view than the advancement of useful knowledge, I now send you these remarks for publication.

In heating the steel, the bars require to be pressed under the surface of the boiling lead (as the steel would otherwise float on its surface), and the magnet should be suddenly shifted from the lead to the boiling water, the instant it has acquired the temperature of the boiling lead; for to leave it longer in the lead would spoil the smooth sur-

face of the steel, and render it as rough as if heated in a furnace or common fire. I am, Sir, yours, &c.,

WILLIAM WALKER, *Q. H. Master.*

Plymouth, October 12, 1847. Lond. Mec. Mag.

Specification of a Patent granted to PATRICK MOIR CRANE, *of Yniscedwyn Iron Works, near Swansea, Iron Master, for Improvements in the Manufacture of Iron.*—[Sealed, April 8th, 1847.]

This invention relates to an improvement in that part of the manufacture of malleable iron where what is called refinery iron is produced, by melting pig-iron in a refinery furnace; and it consists in a mode of employing anthracite or stone-coal in the process of making refinery iron. The patentee says he is aware that this has been before attempted, but without success, on account of the peculiar character of the anthracite or stone-coal, which is liable to decrepitate and fly off into dust on sudden exposure to heat; now, the present invention consists in subjecting the anthracite or stone-coal to heat, before introducing it into the refinery furnace. The preparatory heating may be effected in any convenient way: and the coal may be used either in an ignited or highly-heated state, or in a cold state (having been first ignited or highly-heated). After such preparation, the coal will bear either the hot or cold blast; and whichever blast be used, the patentee prefers that it should be introduced through two or more small tuyeres, instead of one large one. The refining process is conducted in the same manner as when coke or charcoal is used. In the manufacture of pig-iron by the aid of anthracite coal in the blast furnace, a considerable quantity of highly-heated anthracite coal comes from the furnace in lumps, in that process commonly termed by the workmen "throwing off;" and the patentee either introduces these lumps in a heated state into the refinery furnace, or he preserves them for future use. Or, instead of employing these lumps, the patentee causes the raw anthracite coal to be ignited in masses in pits, kilns, or ovens, and, when thoroughly ignited and heated, he carries it direct to the refinery furnace, or preserves it for future use. Although the patentee has used the anthracite coal alone, other fuel may be employed therewith.

The advantages said to result from the use of anthracite coal, according to this invention, are,—that a considerable saving is effected in comparison with the coke of bituminous coal—the cinder contains less iron than that from a refinery furnace worked with the coke of bituminous coal—and in those districts where anthracite or stone-coal can alone be obtained, manufacturers of iron will now be able to refine their iron, which has not hitherto been the case.

The patentee claims, as his invention, "applying, in the manufacture of refinery iron, anthracite or stone-coal, which has been ignited or raised to a high temperature, before introducing it into the refinery furnace."—*Inrolled, October*, 1847. Lond. Journ. Arts & Sci.

Manufacture of Alkali and Chlorine.

Mr. C. T. Dunlop, of Glasgow, has recently obtained a patent for some "improvements in the manufacture of alkali and chlorine, and in the application of the product resulting therefrom;" the first part of which consists in an improved method of producing chlorine, fit for manufacturing purposes, by the mutual decomposition of the following substances:—Muriate of soda, or any other muriate—nitrate of soda, or any other nitrate—muriatic acid—nitric acid. In some instances it is also requisite to use sulphuric acid; and the patentee generally prefers to employ it, in order to obtain, as a residual product, sulphate of soda, suitable for the manufacture of soda, &c. All the above materials may be employed together, or only two of them; as, for instance, a nitrate with a muriate (in which case sulphuric acid must also be used), or a muriate with nitric acid, or a nitrate with muriatic acid, or muriatic acid with nitric acid; in the latter cases, sulphuric acid is employed, according to the results desired to be obtained. The patentee says—he does not confine himself to any proportions, but the process he usually adopts is, to bring together common salt, nitrate of soda or nitric acid, and sulphuric acid, in suitable proportions; heat being then applied, chlorine, an oxide of azote, and muriatic acid, are evolved; these gases are caused to pass through a condenser, charged with sulphuric acid, of sufficient strength to absorb the oxide of azote; and then the chlorine and muriatic acid are separated by means of water. The second part of the invention relates to the application of the product resulting from the above process, and consists in the production of nitric acid from the sulphuric acid, charged with oxide of azote, which is true nitrous sulphuric acid. This is effected by the aid of atmospheric air, steam, and water; and the process adopted by the patentee is, to introduce the nitrous sulphuric acid into a suitable vessel, and, by the addition of water and heat, to effect the disengagement of the oxide of azote, which, being caused to traverse a condenser, together with a sufficient quantity of air and steam, or water, is by this means transformed into nitric acid: this acid may be again used in the manufacture of chlorine, and again recovered, and so on. Sometimes, in place of treating the nitrous sulphuric acid, as just described, the patentee causes the oxide of azote to be evolved, and to pass into a chamber, into which a current of sulphuretted hydrogen is streaming; by which means sulphate of ammonia is obtained and sulphur deposited. The patentee claims the manufacture of chlorine from the materials above mentioned, in the manner described; the process employed for separating the gaseous products, so as to obtain the chlorine in a sufficiently pure state for manufacturing purposes; and the two processes described for utilizing the products resulting from the manufacture of chlorine. Lond. Min. Journ.

Improvements in Casting Cylindrical Pipes.

Mr. D. Y. Stewart, of Montrose, has taken out a patent for a new

mode of casting iron, water, or gas pipes, or other cylindrical tubes; by which a far more superior material is produced, at a much less cost than by the usual method. The mould consists of a perpendicular cylindrical iron box, of the required size, with a shaft in the centre, longer than the mould, and communicating with machinery above, by which it is kept revolving, and, as it revolves, it gradually rises. At the bottom of this shaft is an instrument. which may be termed a "presser," or "rammer," consisting of an iron block, having inclined tabular faces, of such smaller diameter than the box, as to leave the sand of the required thickness for the mould. On feeding the sand at the top of the box, it is distributed towards the sides, and the shaft and rammer, gradually revolving and rising, press it with great force against the side of the box, leaving the mould finished and perfectly cylindrical on its arriving at the top, ready for the insertion of the core. The amount of pressure against the sand is regulated by means of a counterpoise weight. The following are the advantages claimed by the patentee :—" 1. A perfectly straight cylindrical pipe, of uniform thickness.—2. No parting or joint of any kind.—3. Dressed at one-half the ordinary cost.—4. Less sand used than in any other way, and, of course, easier dried, if required.—5. The castings and sand easier removed from the boxes than in the ordinary way.—6. The flasks, or boxes, better calculated to resist the pressure of the metal than any now in use.—7. This method is the best for casting pipes perpendicularly that has hitherto been employed.—8. The greatest recommendation of all is, the simplicity of the apparatus, which requires the attendance of a boy only, who with my machine, as at present working, turns out easily six pipes, six inches bore, per hour." We understand that two miles of water-pipes have been laid by the patentee at Montrose, and the Town-Council passed him a vote of thanks. Some capitalists have joined the patentee, forming a company, and ground has been secured in Glasgow, where premises will be erected for carrying on the business on a large scale.

Lond. Min. Journ.

On a New Process of Engraving, called Stylography.

A new method of engraving has been invented by M. Schœler, a native of Denmark. In 1842, M. Schœler had so far perfected his invention as to produce satisfactory results, which were submitted to the King of Denmark, who rewarded the invention on the condition of his publishing a complete description of his method. In conformity with this agreement, he has just published the particulars of the process at Copenhagen, and has also made it known at Bruxelles. The Academy of Sciences of this latter city approved of it in its sitting of the 4th December, 1846. M. Buschman d'Aurey subsequently made use of it at Antwerp, and, on the 18th of last May, his experiments were submitted to the Academy at Bruxelles.

One part of copal, three of stearine, and three of lac are melted together, and a sufficient quantity of Frankfort black is added to render

the composition black. The whole is melted in a mould about six lines (or half an inch) in depth, formed of two sheets of copper, which are first rubbed over with an amalgam of tin, and whiting and Tripoli, blackened over the flame of a lamp. The sheet of composition is then to be taken from the mould; it will come out easily, and will harden on contact with the air. It is afterwards to be rubbed with a solution of resin in spirits of wine, and polished; and before it is quite dry it is to be covered with silver powder, until it is like a sheet of white paper. The design is then to be counter drawn on it in red, and the whole is to be gone over with a dry-point or graver, the different shades being regulated by cutting to greater or less depths, and varying the width of the lines as well as the distances between them.

The design being engraved, it is to be cleansed with water, and covered with a solution of sugar mixed with a small quantity of nitrate of silver, and bronze powder laid on with a brush.

It then only remains to apply the known processes of galvanoplastics: first, a plate is formed in relief, and from that the plate is produced which is to be printed from, in the same manner as etched or engraved plates. The principal advantage of M. Schœler's process is a saving of labor to the engraver, as he draws in black on a white ground, in the same manner as with pencil and paper.

The results hitherto obtained, although satisfactory, must be merely regarded as slight indications of what may be done by this process in the hands of skilful artists, when some apparent difficulties incident to all new industrial processes (such as lithography, for instance) shall have been made to disappear by practical experience.

If, however, M. Schœler's process does away with some disadvantages which are frequently encountered in the ordinary process of etching, and which are unfavorable to the production of good engravings, it necessitates an extra operation (that of electrotyping) which occasions a certain expenditure of time and money; but it is not unreasonable to suppose that by experience some improvement will be effected in this part of the process. It is not likely that *Stylography* will ever rival line-engraving in beauty; but it possesses over it the advantage of not requiring for its execution one-tenth part of the time: and, moreover, by this means the artist may himself engrave his design with even greater facility than it could be lithographed; which is a great advantage, when he wishes to produce a great number of copies of his work.

M. Schœler has sent thirteen specimens of his works to the Royal Academy at Bruxelles, consisting of two landscapes, three studies of heads, portraits of Frederick VI. and Beethoven, portraits of Lord Byron at several periods of his life, and five finished studies of heads, amongst which, an oriental study, about four inches high, is a very excellent specimen, as the finest and most delicate lines, produced by the point, are well brought out. Several of these specimens have the fault of too much vigor, or rather perhaps too much hardness and dryness; a very skilful hand being required to handle the point lightly, and to produce effective shadowing; but this is easily acquired by ar-

tists, as will be seen from the perfection which has been arrived at in lithography.—*Bulletin de la Societé d'Encouragement.*

Lond. Journ. Arts & Sci.

Extracts from Proceedings of Cornish Scientific Meetings.

Apparatus for ascertaining the specific gravities of bodies expeditiously.—This was invented by Mr. R. W. Fox, who said that, in visiting Wales a month or two ago, it appeared to him that it would be important for the iron smelters there (buying as they do Cornish and other kinds of ore), to have some apparatus for easily ascertaining the specific gravity of ores, that having reference to their richness. He had since then constructed a little apparatus for weighing quantities. The principle depends upon the weight of water displaced, as indicated by an external graduated tube, the amount of the displacement being the divisor of a body weighed in air. The apparatus is also capable of acting as a balance by the use of a close cylinder, which by sinking in the water raises the water in a tube carefully graduated; so that, when the water is brought to the zero point, every substance put into the cylinder of any kind, and however divided, will have its weight indicated in the tube. The apparatus is applicable to weighing ores of all kinds, and to detecting the presence of any metallic substance in stony matter. For instance, he knew the specific gravity of quartz or slate, and, if it exceeded that, he should suspect there was some metallic matter in the stone, and the weight would show the amount of metallic matter. He believed it would ascertain the specific gravity to the third figure of decimals. The adjustment of the zero is easily accomplished by a little cock below the tubes, and the construction of the apparatus is very inexpensive.—Mr. Fox, in giving a further account of this instrument on the following day, said he could weigh substances, whether iron, manganese, tin, or any kind of ore, of which he wished to obtain the specific gravity, that having always reference to its richness. He might first weigh it in a common balance, or he had the means of weighing it by the water balance in the instrument itself. After stating the manner in which he had carefully graduated the scale, he weighed some quartz pebbles by means of the instrument, which amounted to 2560 grains—this being the same, he stated, as if they had been weighed in a common balance. He next weighed the same pebbles in water, the difference between that and the weight in air giving the specific gravity. The weight in water was 1050 grains, which being used as a division of the weight in air, 2560 grains, gave the specific gravity as 2·438, or nearly two and a half heavier than water. The instrument, he said, was capable of testing the weight, as compared with water, of any earthy substance, of soils, or of any lighter substances than water, by pressing them down. He thought that, for testing the specific gravity of tin, iron, or manganese ores, the utility of the instrument to miners may be very considerable.—Mr. John Taylor spoke of the benefit that must result from the use of such an instrument as that invented by Mr.

Fox. Supposing, for instance, that lead ore was mixed with quartz, this instrument would afford a ready way of determining the amount of metallic substance in such ore. A large quantity of iron ore was now exported from this country, which ore was very homogeneous in its metallic character, and might be determined by the ascertained specific gravity of any sample. It was very desirable to have a ready way of finding this specific gravity, and he considered that Mr. Fox's instrument was well deserving the attention of his brother miners.—The President expressed his delight to hear that the Cornish iron mines were more productive than they had been in time past.

Improved Counter, or Plegometer.—This machine, the invention of Mr. E. T. Newton, of Camborne, was thus described:—This counter is intended to register the exact space passed through by the piston of a pumping engine. On the examination of this instrument, when attached to the engine, it will be found that the slightest movement of the piston (when making the stroke) is shown in a proportionate degree on the index, and that on the return of the same it stands still, so that every inch traversed is accurately shown. The cause of difference in this and the old counter arises from the falling of the pendulum when the engine has gone about three-fourths of her stroke, and even should she stop here, the latter tells the full stroke; whereas, *Newton's Improved Counter* registers only the *exact* space passed through by the piston. From the simplicity of its construction, it is not so liable to get out of order as those heretofore exhibited, being free from clicks and the ratchet, which have been found not to answer. This instrument is attached to the gudgeon of the bob by a shaft, or rod, on the extreme end of which is a lever, with a connecting rod to a second lever, so constructed as to be adjusted to any length of stroke; under the instrument is fixed a friction-wheel, composed of a mixture of zinc and lead, with grooves on its edge; into these are fitted two springs attached to the lever, and two others of the same kind fixed directly opposite; so that when the lever is being lifted by the motion of the bob, the springs attached thereto act by pressure, whilst the others yield, and on return of the stroke they act *vice versa*. It will be seen, from the report of Mr. Lean, that this counter has been applied to the engine at North Roskear Mine for six months, ending Aug. 25, 1847, and the result shows an average loss of seven inches per stroke, and 3·3 millions on the duty of the engine per month, during that period.

Machine for Registering the Variation in the Velocity of Pistons.—This machine was described as follows:—It consists of a cylinder (on the circumference of which is placed the paper on which the observation is to be taken), driven by a connexion being made with any convenient part of the beam, and an arrangement of a crank and levers, or other suitable means for producing the regular reciprocating motion of an arm carrying a pencil at its extremity, resting on the circumference of the cylinder. In the model, there was a narrow cylinder attached by a pinion and wheel, for its more convenient adaptation to engines having a long stroke. When the piston is at rest, the pencil will describe a straight line across the paper, extended for its

reception; the latter being set in motion by the revolution of the cylinder, a series of curves varying according to its velocity will result. By dividing these curves longitudinally into any number of equal parts, the velocity of the piston during any part of its stroke may be easily obtained. The inventor stated that the observations may be preserved, and the results obtained at any period from the time of observation with mathematical precision. Other means, he stated, for producing the reciprocating motion of the pencil may be adopted with advantage, that made use of being not quite so uniform as it should be—a circumstance referable to inexperience, and a want of time for its rectification.

New Application of Magnetism.—It was proposed by Mr. James Way, of Burncoose, to apply the magnet, not at once as a motive power, but to the economy of power obtained through other agencies—and this by employing it to lessen the friction of rotatory or oscillating bodies. In the model illustrating this proposition, a permanent magnet is fixed over the vertical axle of a wheel—the axle being of iron, and the magnet so nearly in contact with the surface of the upper end of the axle that the weight of the wheel is nearly, but not completely, balanced by the magnetic attraction. On giving motion to the wheel by the descent of a weight, it will be found that the momentum acquired is sufficient to keep the wheel in rotation for a definite period, and that this period is considerably greater when one of the poles of the magnet is brought in close proximity to the end of the axle, than when so far distant that the axle is beyond the influence of the current. The writer has found, from repeated experiments, that when the magnet is effectively placed, the descent of the weight causes the wheel to continue revolving during 30 seconds, whilst on its removal this period is reduced to 20 seconds. In other words, the amount of power *gained* or economised, and capable of useful application, is in the case of the model exhibited, not less than 50 per cent. on the whole of the power which would be of service were the magnet dispensed with. The friction of rotating bodies being (as shown by Couloumb) in direct proportion to their weight or pressure on their centres, the writer submits that a magnet of suitable power may be so placed over the axis of a wheel, revolving either vertically or horizontally, as to reduce the friction to a minute fraction of its original amount, this remaining fraction being due to the necessity which would exist in practice for allowing the weight of the wheel to preponderate slightly over the lifting tendency of the magnet. Although probably incapable of being economically applied to massive machinery, it is believed that in increasing the delicacy of chronometers, of balances, and even of the magnetic needle itself (in the mariner's compass), and of all the lighter forms of mechanism in which friction is a formidable evil, the employment of permanent magnets as anti-friction agents might be successfully resorted to; whilst electro-magnetism, giving the command of weapons vastly more powerful, might even be available in the case of larger rotating or oscillating machinery.

Lond. Min. Journ.

Specification of a Patent granted to JOHN ROBERT JOHNSON, *Nelson Square, Surrey, for Improvements in Purifying Gas, and in the Treatment of Products of Gas Works.*

This invention consists, first, in a new mode of purifying gas (used for the purpose of illumination) from those impurities which consist of ammonia and its compounds. Ammonia exists in gas after it has passed the condensers and before entering the lime purifier, in combination with several volatile acids, for example, the hydrosulphuric, hydrocyanic or prussic, and carbonic acid. When the gas has passed the lime purifier, these compounds have become decomposed, the lime combining with the acids before mentioned, and liberating the ammonia, which is then found in the gas in the uncombined or so called caustic state. Various plans have been proposed to effect the separation of the ammoniacal compounds. Dilute acids have been employed, and likewise solutions of metallic salts, such as the chloride of manganese. These plans have, however, the disadvantage of requiring a considerable increase of pressure to force the gas through the fluid; and the use of motive power is sometimes required to render the operation successful. To obviate these inconveniencies, and to effect the separation of the ammonia, the patentee employs substances possessing the property of absorbing ammonia or its compounds in the dry or, more properly speaking, solid state, instead of in the state of solution, as has been hitherto practised. All the fluid substances which possess the property of absorbing ammonia and its compounds have, as far as the patentee's experiments extended, been found to possess the same property when employed in the solid state, provided they were used in a divided or pulverulent form, and that they contain sufficient water of crystalization or hygrometric moisture to bring the gas and solid matter within the sphere of affinity. The substances which possess this property may be divided into two classes:—First, those which act on the compounds of ammonia in the manner of the acids, that is to say, which absorb the ammonia only, and which liberate, or only partially absorb, the acids with which it was previously in combination. Among this class of substances are comprised the solid acids, such as the phosphoric, boracic, and other acids; the salts with excess of acid, as the bisulphates of potash, of soda, and of ammonia; the biphosphates of these bases, and other salts of this class; the salts of alumina and of some other earths. Second, those substances which absorb the compounds of ammonia entirely, acid as well as base, entering into combination with the components of the substance used; the metallic salts, containing the requisite quantity of water, are comprised in this class, and will serve more or less perfectly for the purpose required; but the salts of iron and manganese, from their cheapness, will be found preferable to others.

The mode which the patentee adopts for carrying out this part of his invention is as follows:—He takes, for example, one of the substances included in the second class, viz., the sulphate of iron or com-

mon green copperas of commerce (as usually found in commerce it is in the state of crystals, dry to the touch, but containing a large quantity of combined water, or water of crystalization), and this salt he reduces to powder, in the ordinary way. The finer the powder, the more complete will be the decomposition of the salt by the ammoniacal compounds. This powder is employed in precisely the same manner as the moistened lime is used in what are called dry lime purifiers; that is to say, it is spread upon the shelves of a purifier, constructed like that used for the dry lime only; and the subsequent part of the process is the same as with dry lime, the cover being lowered and sealed, and the gas allowed to pass until the application of a piece of turmeric, or other test-paper, shows that the material ceases to absorb the ammonia. When this point is arrived at, the gas is turned into another purifier, similarly prepared, and the one just saturated is emptied. It should be remarked that, although but one purifying vessel is mentioned as being used at a time, yet the operation is more perfectly effected when a series is employed, as in the lime purifiers, and is as well understood. The purifier, or series of purifiers, containing the substance used for absorbing the ammonia, is preferred to be placed so as to receive the gas before it enters the lime purifiers, as the acids in combination with the ammonia are then absorbed by the substance, (when belonging to class second,) the quantity of time required for the purification of the gas is diminished, and the union of one of these acids (the hydrocyanic) with the salt of iron gives rise to a useful product. When employed subsequently to the passage through the lime purifiers, one of the substances of class one will be found most advantageous.

The patentee finds the water of crystalization in sulphate of iron is sufficient to bring the salt into a fit state to effect the absorption of the ammoniacal compounds; but he does not confine himself to the use of salts in their natural state; for the salts may have a certain quantity, more or less, according to their nature, of water added, beyond that which they naturally contain; the powdered sulphate of iron, for instance, if slightly moistened, so that it hangs together, acts equally, as in the former case, and rests better upon the shelves of the purifier.

The second part of the invention consists in a new mode of treating the ammoniacal liquor of the gas-works, for the purpose of preparing the salts of ammonia in a purer state than they have been usually obtained, and without the noxious exhalations which attend the ordinary mode of operating. In treating the ammoniacal liquors by the ordinary process, a large quantity of highly offensive and deleterious gas (sulphuret of hydrogen) is evolved; and, to remedy this inconvenience, it has been proposed to distil the liquor, mixed with a large quantity of lime, condensing the vapors and passing the products of condensation into an acid. Another plan is, to evaporate the liquor with or without lime, and to pass the vapors through acid without condensation. In the former case, in carrying the operation into practice on a large scale, it was found that deposits of lime were obtained, and that the process was thereby rendered dangerous and otherwise objection-

able. According to the second plan, unless lime be used in the evaporation, the operation is unsuccessful, as the noxious gas is generated when the vapors come into contact with the acid, and must be got rid of, thus resembling the old process. These inconveniences the patentee proposes to obviate by operating in the following manner:—The liquor is placed in a vessel similar to an ordinary steam-boiler, and heat is applied thereto by means of a furnace. The liquor consists principally of hydrosulphuret and carbonate of ammonia, with small quantities of other salts of that base. As soon as the temperature rises the hydrosulphuret of ammonia comes over, it being the most volatile product; a slow fire is kept up, so as to volatilize this product exclusively; and as it is given off it is conducted by a branch from a horizontal pipe into a vessel containing a solution of some substance which has the property of absorbing the sulphuretted hydrogen—the deleterious gas. The salts of iron and manganese possess this property, as has been already stated; and alkalies, or lime, mixed with water, will also effect the same object. In the former case, the product, after sufficient of the vapors have passed to saturate the material employed, is a solution of a salt of ammonia, holding in suspension the sulphuret of iron, or manganese. In this plan, one vessel for holding the material through which the vapors are passed is sufficient; but if more be employed, they are charged with the same solution. When lime, or alkali, is used to absorb the sulphuretted hydrogen, the ammonia is liberated, and must be conducted into a second vessel charged with an acid. At the end of this part of the operation, that is when all the hydrosulphuret of ammonia has passed over, the products found in the first vessel are sulphuret of lime and some free ammonia, and in the second, a solution of a salt of ammonia. If the acid was but slightly diluted, the solution may be obtained saturated and fit to crystalize on cooling. The liquid remaining in the boiler, and now consisting principally of carbonate of ammonia, may be treated in the ordinary way for preparing the salts; that is, it may be neutralized with an acid, and the resulting solution evaporated in lead vessels, to obtain the crystals of the ammoniacal salts, as is well understood; or the evaporation may be continued in the boiler at a higher temperature, in order to drive over the other volatile salts, and the vapors passed through acid to absorb the ammonia. In the latter case, the apparatus just described may be used, a cock in the horizontal pipe being opened. The vapors then pass through the horizontal pipe, and down a branch-pipe into the second vessel containing the acid, without entering the first vessel containing the lime, and are then absorbed. The evaporation is continued until the volatile salts of ammonia are all driven off, when the liquor in the boiler may be rejected, unless it be found that the fixed salts remaining in the liquor are in sufficient quantity to be worth extracting, which may be ascertained, approximatively, by evaporating a drop of the liquor on a strip of glass, or accurately, by evaporating, nearly to dryness, a known quantity of the liquor, and by weighing the resulting salt. These fixed salts may be obtained by entirely evaporating the liquor in a leaden vessel, or by adding to the liquor, while in the boiler, a certain quan-